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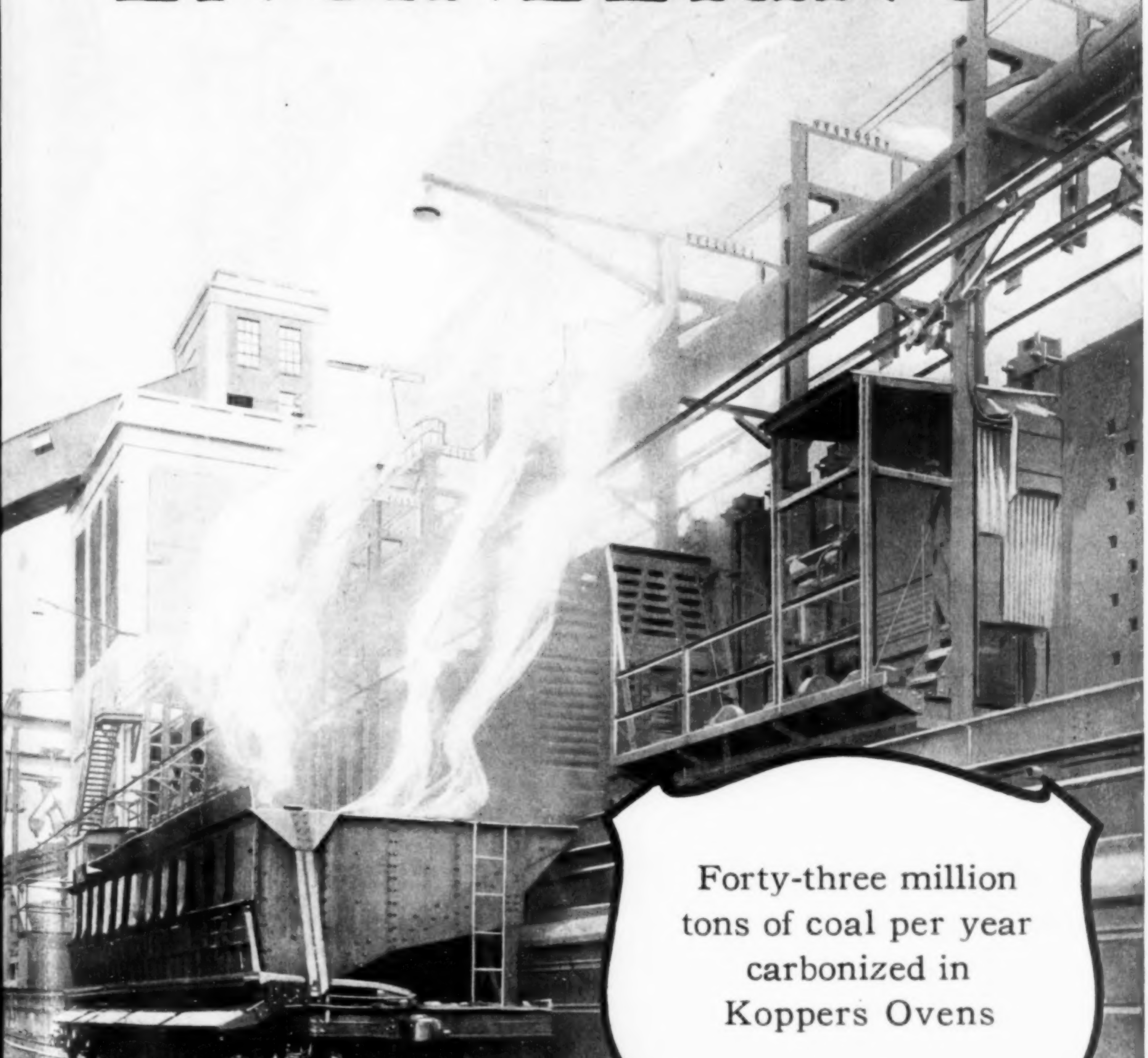
CHEMICAL & METALLURGICAL ENGINEERING



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American Engineering Council Founded Under Hoover's Direction

IT WOULD be difficult to conceive more favorable auspices for the launching of a new organization than those surrounding the first meeting of American Engineering Council. The hearty response given by seven national societies and fourteen local organizations, the latter from eleven different states and the District of Columbia, to the invitation for charter membership can be considered a fair index of widespread interest in the civic duties and opportunities of the engineer. With so many organizations ready to unite for a common purpose, it was doubly fortunate that they were able to find in HERBERT HOOVER a leader who typifies not only the ideals but the achievements of engineers in public service. These two factors—the widespread interest in the movement and the acceptance of leadership by Mr. HOOVER—augur well for the success of American Engineering Council.

It is typical of Mr. HOOVER that he should propose immediately a very definite and tangible work for Council—namely, an investigation of industrial wastes in time, labor, material and money. But it is more than a coincidence that he should have suggested this as its first work. He has long been interested in the subject. He was vice-chairman of the Second Industrial Conference, which made constructive suggestions for new and improved relations between employer and employee. Only recently he was invited to sit in conference with Mr. GOMPERS and other officials of the American Federation of Labor, for the purpose of formulating a program of readjustment on the economic problems now confronting the country. Perhaps it was as a result of that conference that news later emanated from the American Federation of Labor announcing a new attitude toward engineers. Mr. WOLL, vice-president of that organization, is said to have stated: "The viewpoint of the engineer is valuable because it is the viewpoint of a man whose position is such as to enable him to see the whole broad problem involved. He is in a position to know fully the value of being able to realize the creative energy of workers, to bring into play their interest and intelligence."

Here is tangible evidence of the influence of engineering thinking on economic problems and an acceptance by one of the great factors in industry of the soundness of the engineer's viewpoint. We hope that developments will show that American Engineering Council has come into being at an opportune moment, when different elements in industry realize the value of engineering thought and opinion on vital economic problems. A happy conjunction of events points in that direction. A sense of professional solidarity has been aroused. There is work to do and a united disposition to do it.

Psychology of Inflation And Readjustment

IN RETROSPECT, what has occurred in business and industry generally since the Armistice seems natural enough. There was a reaction from war-time conditions. Sellers had been restricted as to prices, either by law, by agreement with the Government or by conscience, and when restrictions disappeared most of them were disposed to secure the highest prices obtainable. Workmen had worked hard during the war and were disposed to relax afterward, endeavoring to get the most money for the least service.

Many men were misled by false logic. In the experience of a generation before the war, activity and prosperity had gone together, and it was inferred that activity meant prosperity. But that was not the case; there was much activity that did not involve real prosperity or progress. The country's experience after the Civil War had been forgotten. For eight years after the Civil War there was great activity, except for a few short periods, but when the panic of 1873 came it was found that there had not been a corresponding degree of prosperity and progress.

For the present, however, our disillusionment has come and the reaction from war-time conditions has spent itself. Men are getting over their spell of endeavoring to do the least work for the most money. These changes are chiefly psychological.

A clear distinction must be made between business conditions that arise from psychological influences and those arising from material influences. In 1908, after the panic of October, 1907, there were some "sunshine clubs" formed. It was preached that the depression was all in men's minds and prosperity could be created by establishing what was called "confidence." The scheme did not work. There was a five-year industrial depression from 1873 to 1878 and another of equal duration from 1893 to 1898. In neither of those periods would it have been possible to make business "good" by men changing their minds. Those depressions were not psychological at all. The country had over-expanded. Facilities had been created that were not needed. Liquid capital had been turned into fixed capital to too great an extent, and the capital could not yield an adequate return.

That is not the condition today. The country has too little railroad facilities. There is not too much capital tied up in railroads, but too little. There are not too many dwelling houses and skyscraper office and hotel buildings, but too few. There is no physical foundation for a business depression. The depression is due to wrong mental attitudes that must be replaced by right ones.

The readjustment, whereby we shall attain an industrial activity that will involve real prosperity and advancement, consists in mental attitudes being

changed. Manufacturers, wholesalers and retailers must become reconciled to receiving smaller profits and working harder for those profits. Labor must bring itself to work harder and more intelligently and be content in many cases with smaller pay in dollars, though the purchasing power of the month's earnings may eventually be increased.

Mass psychology, however, seems endued with a characteristic akin to momentum. Sometimes it swings so far that it swings part way back again. It is quite possible that while everyone is now talking about "readjustment" and predicting that we shall in this readjustment get to a perfectly sound and safe basis, we may after all have another reaction toward inflation from which in turn we shall have to recover. It is doubtful, in other words, whether everything will be "fixed up" to stay.

Ignorance Of Science

IN THESE days when the colleges are being criticised from various points of view and many innovations are being introduced into education, anything that throws light upon the subject should be welcome. One of the most illuminating criticisms of the failings of education is contained in H. G. WELLS' recently published "Outline of History." Mr. WELLS, as is well known, received a scientific education and believes, as HUXLEY did before him, in the need for leavening the old-time classical studies with a considerable proportion of well-taught physical science.

It is in his account of Mr. GLADSTONE that Mr. WELLS assails the old pedantic education that, in spite of its virtues, has so hampered our colleges. Mr. WELLS explains the old-time classical training as consisting mainly of "the study, without any archæology or historical perspective, of the more rhetorical and 'poetic' of the Latin and Greek classics." The graduates from such a course, continues Mr. WELLS, had no vision of history as a whole, were ignorant of the elementary ideas of biological science, of modern political, social and economic science and modern thought and literature. Such an education as Mr. GLADSTONE'S is typical of that of many of our public men, lawyers and even some business men. Mr. WELLS' test of an education is whether it enables one to interpret correctly the life around him; of Mr. GLADSTONE he says that he never attained any real vision of the world in which he lived.

For instance, "When Mr. GLADSTONE was taken by Sir JOHN LUBBOCK to see CHARLES DARWIN, he talked all the time of Bulgarian politics, and was evidently quite unaware of the real importance of the man he was visiting. DARWIN, Lord MORLEY records, expressed himself deeply sensible of the honor done him by the visit of 'such a great man,' but he offered no comments on the Bulgarian discourse." Obviously this Eton and Oxford graduate, intellectual as he was supposed to be, had little conception of the world-moving importance of DARWIN'S work in science. Therefore, reasons Mr. WELLS, since he could not interpret correctly the life around him, he was not educated.

Again, Mr. GLADSTONE paid a visit to FARADAY, "the English electrician, whose work lives wherever a dynamo spins, who is in the airplane, the deep-sea cable, the lights that light the ways of the world, and wherever electricity serves our kind . . . The man of science tried in vain to explain some simple piece of apparatus to this fine flower of the parliamentary world. 'But,' said Mr. GLADSTONE, 'after all, what good is it?' 'Why, sir,' said FARADAY, doing his best to bring things home to him, 'presently you will be able to tax it.'" If Mr. GLADSTONE could see the great power-houses and electric lines today, all of which have come from FARADAY'S humble experiments of a century ago, he would see "what good it is"; and he might see also how poorly his education in what Mr. WELLS calls rhetorical literature fitted him to understand the progress of his time.

But Mr. GLADSTONE is not the only prominent man who has failed to do justice to science because of a narrow education. Our own Congress hesitated six years over voting $30,000 to test MORSE'S telegraph, even after he had demonstrated its merits. When the appropriation was being discussed, one Congressman proposed an amendment that half the money be given for an investigation of mesmerism. When the vote was taken on the original motion, (the amendment having been defeated), it carried by only 89 to 83. MORSE meanwhile had nearly starved to death, after vainly trying to get European nations to buy his invention.

Coming down to the present, it is not difficult to see similar blindness to the importance of science by men trained according to the old classical standards. Congress still votes huge appropriations for more or less useless projects, while cutting to the minimum any sums devoted to engineering or to scientific research. When, occasionally, large amounts are voted for necessary engineering undertakings, men untrained in science are as likely as not to be put in charge. Engineers and technologists employed by the national, state and municipal governments are given as little authority as possible, and are paid salaries astonishingly small compared with what Government-employed lawyers and publicists are paid.

One of the most striking examples of lack of knowledge of science is in our newspapers and general magazines. Reporters with almost no understanding of science are assigned to write accounts of scientific importance, and the way in which they garble the facts and falsehoods they pick up is a disgrace. The apportionment of space in the newspapers further emphasizes the prevailing ignorance of science among men who have received the traditional arts education. Half a page is devoted to a murder or a scandal, or even to a wedding or a society rumor, whereas a tiny paragraph in the lower corner has to do for an important scientific discovery.

It is interesting to observe how ignorant people in general are when a scientific matter is mentioned. Speak in the ordinary club or at a general social gathering some such term as "organic acid" or "fuselage" or "metallurgy," and notice the blank looks that follow. As HERBERT SPENCER pointed out, the customary education that most people receive makes them more anxious to pronounce correctly some word of merely literary significance, such as "Iphigenia" or "Don Quixote" or "L'Allegro," than to understand the scientific phenomena among which they live. Listen to the remarks of the average citizen as a street car passes a bridge under course of construction, or when the composition of the latest anarchist bomb is discussed. In spite of all the books on science available, and all the science courses in our schools and colleges, the average citizen, like the lawyer and the reporter and the public man, is astonishingly ignorant of science and engineering.

Concerning Communism

TO THOSE whose mental make-up is such that they shrink from the increasing intensity of the competitive organization of society, the complete fiasco made in the most colossal communistic experiment of all history—Soviet Russia—must appear as a deathblow to their hopes. To the hypothesis of a possible communistic organization of society there attaches a fascination akin to the search for perpetual motion. Primitive men looked upon the competitive beasts of prey with fear and aversion; but the bee, the example par excellence of communism in the animal world, they regarded with admiration of his energy and efficiency mingled with respect for his powers of self-defense. It is natural, therefore, that throughout the ages men have been attracted by the idea of pooling their resources so that each should contribute what he best could to the common store and each withdraw from it in accordance with his needs.

But the verdict of human experience to date is that, except under special circumstances and to only a limited degree, such an organization simply will not work. To the engineer it is at once evident that there are certain fundamental factors in such a plan. The total amount contributed by the group must exceed the total withdrawn by a factor of safety sufficient to create a reserve that may be drawn upon in periods of heightened consumption or lowered production, otherwise the project will collapse, as it has in Russia.

A close analogy would be with a life insurance association, where the premiums paid in must be sufficient to meet the death payments and create a reserve to tide over periods when payments are unusually heavy. The life insurance problem is not difficult when sufficient actuarial data are available, for the amount of the payments is agreed upon and it remains only to fix the amount of the premiums. But there can be no actuarial data for a communistic society, because "the sky is the limit" for the demands that may be made upon it and there is no means of determining the amount which the individual must contribute. We say must contribute, but pure theoretical communism simply predicates that each shall contribute according to his ability and withdraw according to his needs, in the simple faith that the Providence which looks after three well-known groups (one of which is fast vanishing) will somehow arrange it that there will always be enough for all.

However, every time the experiment is tried there never is enough for all. The reasons why are two—optimism and ambition. Mankind on the average tends to believe that everything will come out all right; the Chinese expression for "tomorrow" is *ming tien*—"bright day." If everything will come out all right "there is no use breaking our necks," "you only live once, you know," and so mankind on the average is a little slack, needing some spur or urge to bring out its full powers. And mankind is ambitious; few there are who have attained the Nirvana of having their desires no greater than their means of gratification and those who have so attained are far above the level of the average. With such material to work upon, the engineer can prophesy the outcome as easily as he can prophesy what will happen when the flow from a reservoir exceeds the input.

Communism cannot work except by the remodeling of human nature.

Trade Secrets and Industrial Chemists

SOBER reflection over the thoughts advanced at the Chicago and Milwaukee A.C.S. intersectional meeting detailed elsewhere in this issue leads to the conclusion that much information on chemical processes is now being uselessly suppressed to the retardation of industry. Trade secrets are in a large majority of cases the common property of operators within the trade. The only object in the suppression of such information is to prevent competitors from profiting thereby. But since they are already advised, an open procedure can work no harm. It may do inestimable good to other industries; for it is always true that operation in one industry may be modified for profitable adaptation to work entirely outside the line in which it originates.

There are exceptions to spreading information immediately in the case of patents and certain nonpatentable mechanical features. Time is the governing factor, however. The other fellow soon discovers the new development.

A certain manufacturer has very rigid rules regarding secrecy of his operations. He signs up his employees, surrounds his plant with mystery and a high board fence. But the fence is not high enough to hide the heavy niter fumes issuing from the towers of his sulphuric acid plant. Directly across the street is a large set of acid chambers operating at full capacity. Not the slightest mist is apparent over its stack. This plant is operated by a company with a broad open-handed policy that makes for advancement throughout the technical departments. The first company cannot well muster the "brass" to ask to inspect the plant where other folks are welcome. They will probably send a representative in the dark of the night or disguised as a workman to find out how it's done. Meanwhile the fume waves in the prairie breeze like a flag proclaiming ingrown industrial degeneracy to the passing chemist.

When you feel secretive, remember the other fellow may have a better line of information than yourself. Dissemination of information brings returns and is therefore not simply altruistic.

Civil Engineers And the Federation

CORRIDOR gossip at the recent meeting of American Engineering Council in Washington concerned the action of the Civil Engineers in declining by a decisive majority to join the new organization. While regret was expressed that the A. S. C. E. had not seen fit to unite with the other founder societies in the movement for public service, the opinion was frequently ventured that the Civils would yet change their minds and come into the fold. The situation reminded one of that other time when they stood upon their dignity and declined to join the founder societies in accepting Mr. CARNEGIE'S offer of a permanent home. Subsequently, after everybody was settled in the building, they decided to come in.

No fault can be found with the action of the Civil Engineers in declining to join American Engineering Council. One may question, however, whether the Board of Direction of the A. S. C. E. was not exhibiting a petty attitude and a dog-in-the-manger policy when it formally directed its representatives on the present Engineering Council to decline to transfer the activities of that body to American Engineering Council.

First Meeting of American Engineering Council

An Account of the Organizing Sessions at Washington, Nov. 18 to 20—Twenty-one Member-Societies Join the Federation—Herbert Hoover Elected President—Washington Selected as Permanent Headquarters—Investigation of Industrial Wastes Authorized

QUITE fulfilling the expectations of its sponsors, the first meeting of American Engineering Council of the Federated American Engineering Societies, held in Washington, Nov. 18 to 20, was a marked success from the point of view of member-societies represented and official personnel selected to launch the organization. Practically all of the three-day session was consumed with the routine of organization, but did not lack in a number of inspirational addresses interspersed with the more prosaic business of putting the Council's machinery in running order.

Herbert Hoover was elected president by unanimous vote, and Washington, D. C., was chosen as the permanent headquarters of Council.

In response to a suggestion made by Mr. Hoover in his address, the Executive Board indorsed his plan for an investigation of industrial wastes, and authorized him to create an organization for that purpose.

Twenty-one Member Societies

The first session was called to order by Richard L. Humphrey, chairman of the Joint Conference Committee which was charged at the organizing conference last June with the duty of bringing American Engineering Council into existence in accordance with the provisions then made. In his opening address Mr. Humphrey reviewed the work of the Joint Conference Committee in keeping in active touch with the 116 organizations which had been invited to join the Federated American Engineering Societies. As a result of its labors this first meeting was called to order with 21 member-societies representing an aggregate membership of about 60,000, which is 50 per cent of the aggregate membership of all organizations invited to join. Mr. Humphrey concluded his address with a review of some of the work which American Engineering Council can undertake.

Complete List of Charter Member-Societies

The complete list of charter member-societies and their representatives as of Nov. 20, 1920, is as follows:

Alabama Technical Association, Birmingham, Ala.: Paul Wright.

American Institute of Chemical Engineers, Brooklyn, N. Y.: Harrison E. Howe.

American Institute of Electrical Engineers, New York: Calvert Townley, Comfort A. Adams, A. W. Berresford, H. W. Buck, F. L. Hutchinson, G. A. Waters, William McClellan, L. F. Morehouse, John H. Finney, Charles S. Ruffner, Charles F. Scott, Lewis B. Stillwell.

American Institute of Mining and Metallurgical Engineers, New York: Herbert Hoover, J. Parke Channing, Arthur S. Dwight, Edwin Ludlow, Allen H. Rogers, Philip N. Moore, P. E. Barbour, Joseph W. Richards.

American Society of Agricultural Engineers, Ames, Iowa: Samuel H. McCrory.

American Society of Mechanical Engineers, New York: L. P. Alford, Charles T. Main, Arthur M. Greene, Jr., E. S. Carman, Arthur L. Rice, Dexter S. Kimball, Paul Wright, W. A. Hanley, William B. Gregory, V. M. Palmer, H. P. Porter, Robert H. Fernald, L. C. Nordmeyer, Fred J. Miller (alternate), Robert Sibley (alternate), Charles Whiting Baker (alternate).

Associated Engineering Societies of St. Louis: William E. Rolfe.

Detroit Engineering Society, Detroit: D. J. Sterrett.

Engineering Association of Nashville, Tenn.: A. F. Ganier.

Engineering Society of Buffalo, N. Y.: W. B. Powell.

Grand Rapids Engineering Society, Grand Rapids, Mich., Burritt A. Parks.

Kansas Engineering Society, Topeka, Kan.: L. B. Smith.

Louisiana Engineering Society, New Orleans, La.: W. B. Gregory.

Mohawk Valley Engineers' Club, Utica, N. Y.: Byron E. White.

Taylor Society: Morris L. Cooke.

Technical Club of Dallas, Tex.: O. H. Koch.

Cleveland Engineering Society: John F. Oberlin.

Engineers' Club of Baltimore, Md.: W. W. Varney.

Society of Industrial Engineers: L. W. Wallace.

Washington Society of Engineers, Washington, D. C.: E. C. Barnard.

York Engineering Society: William J. Fisher, H. A. Delano (alternate).

The following organizations, which are considering membership but have not taken final action, participated in the meeting and sent delegates as indicated:

American Institute of Architects, Washington, D. C.: Percy C. Adams.

American Society of Heating and Ventilating Engineers, New York: Champlain L. Riley.

American Society for Testing Materials, Philadelphia, Pa.: C. D. Young, C. L. Warwick.

Florida Engineering Society, Gainesville, Fla.: L. R. McLain.

Illuminating Engineering Society, New York: Walter C. Allen.

Iowa Engineering Society, Iowa City, Iowa: John H. Dunlap.

National Fire Protection Association, Boston, Mass.: Ira H. Woolson, D. Knickerbacker Boyd.

Society of Automotive Engineers, New York: Howard E. Coffin, David Beecroft, Coker F. Clarkson, H. M. Crane, C. F. Kettering, H. M. Swetland.

Society for the Promotion of Engineering Education, Pittsburgh, Pa.: F. L. Bishop.

Engineering Society of Western Massachusetts: C. L. Newcomb.

Election of Temporary Officers

Election of temporary officers resulted in the appointment of E. S. Carman, American Society of Mechanical Engineers, temporary chairman, and William E. Rolfe, Associated Engineering Societies of St. Louis, temporary secretary. In accepting the position Mr. Carman acknowledged the honor paid through him to the American Society of Mechanical Engineers, which was the first to accept charter membership in the Federation. He also emphasized public service as the keynote of the organization and meeting.

At this point Philip N. Moore offered a resolution of regret that Richard L. Humphrey and his colleagues of the American Society of Civil Engineers, who had worked so zealously for the success of the Federation, were, by the action of their society, eliminated from


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further participation in the Federation's affairs. The privilege of the floor was extended to Mr. Humphrey and his associates.

A number of temporary committees were appointed to formulate immediate business of the Council and report at later sessions. Care was taken to apportion membership on these committees among the national, state and local representatives. These committees and their chairmen were as follows: Program, Percy E. Barbour, A. I. M. E.; Credentials, O. H. Koch, Technical Club of Dallas, Tex.; Constitution and By-laws, C. F. Scott, A. I. E. E.; Nominations, W. B. Powell, Engineering Society of Buffalo, N. Y.; Plan and Scope, L. D. Nordmeyer, A. S. M. E.; Budget, Calvert Townley, A. I. E. E.; Resolutions, F. E. Webner, Society of Industrial Engineers.

Determination of Districts and Representation on Executive Board

In order to constitute the Executive Board of American Engineering Council as provided in the by-laws it was necessary at this point to consider the division of the United States into districts from which the various members of the Executive Board should be selected.

The constitution provides for an Executive Board of thirty, of whom six shall be officers of the Council and twenty-four selected partly by the national societies, and the remainder by the local, state and regional societies and affiliations according to districts. In view of the fact that new member-societies were likely to join the organization and desire representation on the Executive Board it was suggested by L. P. Alford that only twenty members of the board be selected at this time, fourteen from the national societies and six from the locals. This was readily agreed to, as was also the following division of the United States into six districts: 1, New England and New York; 2, Michigan, Wisconsin and Minnesota; 3, Ohio, Indiana and Illinois; 4, New Jersey, Pennsylvania, Delaware, Maryland and District of Columbia; 5, Southern States below the Potomac and Ohio rivers, with Louisiana and Texas; 6, remaining states west of the Mississippi River.

As finally constituted the Executive Board consists of twenty members apportioned among the national societies and the six districts as follows:

American Institute of Chemical Engineers, 1, Harrison E. Howe.

American Institute of Electrical Engineers, 4, H. W. Buck, William McClellan, Charles F. Scott and Lewis B. Stillwell.

American Institute of Mining and Metallurgical Engineers, 3, Arthur S. Dwight, Edwin Ludlow and Philip N. Moore.

American Society of Agricultural Engineers, 1, Samuel H. McCrory.

American Society of Mechanical Engineers, 4, L. P. Alford, Arthur M. Greene, Jr., E. S. Carman and Fred J. Miller.

Taylor Society, 1, Morris L. Cooke.

District No. 1, one-half each for *Engineering Society of Buffalo*, W. B. Powell, and *Mohawk Valley Engineers' Club*, Byron E. White.

District No. 2, one-half each for *Detroit Engineering Society*, D. J. Sterrett, and *Grand Rapids Engineering Society*, Burritt A. Parks.

District No. 3, 1, *Cleveland Engineering Society*, John F. Oberlin.

District No. 4, 1, *Engineers' Club of Baltimore*, W. W. Varney.

District No. 5, 1, *Technical Club of Dallas*, O. H. Koch.

District No. 6, 1, *Kansas Engineering Society*, Lloyd B. Smith.

In view of the fact that all of the societies which have been invited to join the Federation have not yet been able to reach a decision it was the sense of the meeting that the time for accepting invitation to charter membership should be extended to July 1, 1921, and formal action was taken to that effect.

Washington Chosen as Headquarters

Philip N. Moore then brought up the subject of permanent headquarters for American Engineering Council and addressed his remarks particularly to the advantages of Washington, D. C., for this purpose. His suggestion resulted in a lively discussion of the merits and demerits of various locations for headquarters. New York was favored by some on account of its business facilities, while others were favorable to inland cities on account of their central location. In view of the evident time-consuming nature of this discussion and the impossibility of reaching a decision at that session the matter was made a special order of business for the afternoon session. At that time favorable action was taken on Mr. Moore's resolution to the effect that it was the sense of the meeting that headquarters for American Engineering Council should be established in Washington. An amendment to refer the matter to the Executive Board with power to act was lost by a wide margin, though it became incumbent upon the Executive Board later to recognize the sentiment of the Council and formally select Washington as headquarters.

Prior to adjournment of the morning session Mr. Hutchinson, one of the directors of Engineering Societies Service Bureau, New York, told of the work of that organization for the first nine months of 1920. The work of this organization is of interest to American Engineering Council, as the latter is expected to take over its duties. At present the Bureau is expending a total of about $9,000 per annum, but should have a budget of at least $15,000 for 1921. In view of increasing unemployment its service is likely to be much needed during the coming winter, and it was felt that the most efficient service possible should be placed at the disposal of the engineering profession.

Address on Conservation of Labor

The session on Friday morning, Nov. 19, was opened with an address by L. W. Wallace, Society of Industrial Engineers, on "Conservation of Labor." His thesis was that in view of the tremendous loss of labor resulting from the war, as well as the lowered morale consequent upon the general dislocation of business and industry, it was of the utmost importance to increase the potential value of human beings in industrial processes. He mentioned four great factors in accomplishing this end—namely, the safety adviser, the welfare adviser, the industrial medical adviser, and industrial education. He showed statistically the effect of the safety movement in reducing accidents with the consequent loss of time and production. Welfare work, in whatever name it might be undertaken, was, in the speaker's opinion, a failure as long as it was offered as a substitute for wages or other just compensation, but a marked success if undertaken as a conservation measure in the interest of both employer and employee. The industrial medical adviser he found to be an important factor in reducing time lost due to preventable illness. But it was in industrial education that Mr. Wallace

found great hope for the future. Since the trained mind excels the untrained it is of first importance to raise the general level of intelligence of all labor. The object of industrial education should be not so much to make the worker a better machine but to increase his usefulness to society by broadening his mind and developing his intelligence. One of the greatest opportunities of industrial education is to develop intelligent subordinate leaders, foremen, etc. The speaker believed that it was one of the functions of engineers to improve industrial conditions through their recognition of the laws of cause and effect and to devise such means of avoiding industrial waste, and to so administer them that they would accomplish their purpose. He closed his address with a plea for the "industrially handicapped" who now finds it impossible to serve society usefully on account of lack of training. Mr. Wallace was of the opinion that the great loss of labor occasioned by war was making it more and more necessary to make use of individuals handicapped by loss of arms, legs, eyes, etc.

Hoover Chosen as President

The report of the Committee on Nominations was received with the greatest interest because the result of its deliberations was conceded to be of the most vital importance to the success of Council. In making its report the committee explained that it had endeavored to pick men who were imbued with the spirit of public service, which is the underlying motive of the Federation. It also explained that an effort had been made to distribute representatives fairly among the national and local societies. Keeping these factors in mind, it suggested the following officers:

President: Herbert Hoover.

Vice-presidents for a two-year term: Calvert Townley, American Institute of Electrical Engineers, and William E. Rolfe, Associated Engineering Societies of St. Louis.

Vice-presidents for one-year term: Dexter S. Kimball, American Society of Mechanical Engineers, and J. Parke Channing, American Institute of Mining and Metallurgical Engineers.

Treasurer: L. W. Wallace, Society of Industrial Engineers.

The nominations were accepted and the nominees unanimously elected. Mr. Hoover was immediately escorted to the chair amid loud and prolonged applause, the audience rising in recognition of its approval. Mr. Hoover said that he found it impossible to refuse to accept service where it is of importance to the engineering profession and the country at large. He said he had long been interested in giving the engineer a voice in the community and that there never had been a time when his voice was so much needed as now. In view of the fact that he had an important engagement with the American Red Cross it was necessary for him to be excused. Mr. Townley then took the chair and called upon each of the newly elected officers for a brief talk.

Reports of Other Committees

The Council then proceeded to consideration of the report of the Committee on Constitution and By-laws. The committee based its recommendation on the document prepared by the Joint Conference Committee and adopted by the Organizing Conference on June 4, 1920. A few minor changes were made. In Article VI, relating to funds, the sentence reading "No portion of such funds shall be applied to the use of local affiliations or state councils" was changed to read "No portion of such funds shall be appropriated for the operating expenses of local affiliations or state councils." It was felt that the original wording would prevent Council from lending active assistance to local bodies where participation might be desired and needed.

Chapter V of the by-laws, on publicity, was the cause of much irrelevant discussion, but was finally allowed to stand as originally written. The constitution and by-laws were then adopted as amended in minor particulars.

The Committee on Plan and Scope suggested a number of matters of public interest to which Council might devote its attention. This report was subsequently revised in conference with Mr. Hoover and considered by the Executive Board. Their action is announced elsewhere in this report.

In reporting for the Budget Committee Mr. Channing said that they had considered a minimum and maximum income, basing the former on the present actual membership of the Federated American Engineering Societies and the latter on a prospective membership. Under the former an annual income of approximately $59,000 would be available, while the maximum possibility would be $80,000. The fixed expenses for office and overhead, Service Bureau, meetings, committees, traveling, etc., were estimated to amount to a minimum of $56,500 which would be well within the estimated income. The report was accepted for guidance of the Council.

At the evening session of Nov. 19 Mr. Hoover delivered an address embodying his conception of the work of American Engineering Council and outlining in some detail the problems which it might consider. His address is published in full elsewhere in this issue. The evening session was followed by an informal reception and smoker tendered by the Engineering Societies of Washington, D. C. This closed the first meeting of American Engineering Council.

Meeting of Executive Board

The meeting of the Executive Board was convened at 9 a.m. Nov. 20, with Vice-President Rolfe in the chair and C. F. Scott secretary pro tem. The first matter under consideration was the selection of an executive secretary. In view of the importance of this matter the Board appointed a committee to canvass eligible persons and report back to the Board at its next meeting. This committee consists of Mr. Hoover, ex officio; L. W. Wallace, chairman, Box 588, Baltimore, Md., and Messrs. Townley, Moore, Scott, Oberlin and Alford. The committee will be glad to receive suggestions for executive secretary. The Board formally ratified the selection of Washington as headquarters, but deferred selection of offices until the executive secretary is elected. It also extended until July 1, 1921, the time for acceptance to charter mmbrship by those societies originally invited to join the Federation. In accordance with its principle for full publicity the Board decided to establish means for making available to the daily and technical press and the publications of constituent bodies complete information and news relating to the Federation and Council.

Indorsement of Plan to Establish Department of Public Works

The resolution by Mr. Moore recognizing the importance of the movement to secure a federal Department

of Public Works and favoring continuance of efforts to that end brought forth prolonged and earnest discussion, centering chiefly in the question of what kind of support American Engineering Council should give such projects. It was the consensus that Council should not establish the precedent of committing itself to financial support of these movements, but should direct its efforts toward the creation of public sentiment and the preparation of reliable information for dignified and legitimate use. In this connection Mr. Stillwell described the procedure of the French Engineering Council as a medium for expressing the engineer's voice in public affairs. Mr. Moore finally made clear the purport of his resolution and it was adopted.

Discussion of the report of the Committee on Plan and Scope as subsequently modified after conference with Mr. Hoover resulted in the adoption of the following items, which are arranged approximately in the order of their appropriateness and importance:

1. To serve the public interest by investigation and advice to all public governmental and voluntary bodies dealing with national economic problems.
2. Department of Public Works.
3. Conservation of natural resources.
4. Co-operation with other national organizations, technical, industrial and commercial.
5. Technical education.
6. Transportation, particularly highways.
7. Advice to state, regional and local societies.
8. National Bureau of Economic Research.
9. Public fire protection.
10. Patents.
11. National Board for Jurisdictional Awards.
12. International affiliation of engineers.
13. State organization of local affiliations.
14. Licensing and local registration of professional engineers.
15. Classification and compensation of engineers.
16. Engineering Societies' service bureau.

In order that the Executive Board might continue functioning until the executive secretary is elected L. P. Alford was elected secretary pro tem. Matters pertinent to Council's affairs may be addressed to him care American Society of Mechanical Engineers, 29 West 39th St., New York City.

The Executive Board then adjourned subject to the call of the president not later than Jan. 31, 1921.

Canada's Pulpwood Laws and Regulations

When the Canadian provinces were confederated into the Dominion of Canada, one of the articles of confederation conferred upon the respective provinces was the sovereignty and control over their own natural resources. The same authority confers upon the Canadian Parliament the sole power to legislate on matters affecting tariffs as to both exports and imports. Regulations have been adopted by Ontario, Quebec and New Brunswick which require that pulpwood cut from the Crown lands in these provinces must be manufactured into pulp or paper in Canada. These have been summarized by Consul Johnson of Kingston, Ont., in *Commerce Reports.*

An order in council passed Jan. 13, 1900, which was later amended by a law (63 Victoria, chap. 11), requires lumber cut from the Crown lands in Ontario to be manufactured in Canada. It was not until 1902 that this regulation was also applied to pulpwood.

Timber Licenses at Auction

In the Province of Quebec licenses to cut timber on Crown lands are disposed of at public auction. The license thus acquired entitled the holder to "cut timber on ungranted lands of the Crown at such rates and under such restrictions as may from time to time be established by the Lieutenant Governor in council and of which notice shall be given in the *Official Gazette.*" Article 1,598 provides that no license shall be granted for longer than twelve months.

Article 1,600 stipulates that "such license shall vest in the holder thereof all rights of property in all trees, timber and lumber cut within the limit of the license during the term thereof, whether cut by authority of the owner of the license or by any other person with or without his consent."

The regulations now in force by virtue of the first-cited article of the law are embodied in an order in council under date of April 26, 1910, revoking all previous regulations "incompatible with the present" and amended in its turn by an order in council of June 13, 1918.

Other clauses having a bearing on the subject are:

1. All licenses to cut timber are subject to a yearly ground rent of $5 per square mile or fraction of a square mile, dating from the first of September, 1910. They are granted for twelve months, from the first of May to the thirtieth of April, and after their issue no claim shall be admitted for the repayment of any overcharge for ground rent or fire tax due to the incorrect measurement of the area of the limit.
2. Licenses expire on the thirtieth of April following the date of their issue, but the licensee having complied with existing regulations is entitled, up to the first of September following, to a renewal of his license. He shall forfeit such right through any infringement of the law and of the regulations. The Minister of Lands and Forests may, however, permit the renewal of the license on payment of the ground rent and of any other penalty he may be pleased to impose.

Besides increasing the stumpage dues, the amendment adopted in 1918 also raises the ground rent to $6.50 for the years 1919-20 to 1923-24 and to $8 for the years 1924-25 to 1928-29, inclusive, and provides that in the case of licensees who do not exploit their limits such ground rent may at any time be augmented, the Crown to determine the quantity of wood to be cut for constituting sufficient exploitation. "Transfers of limits or of divided or undivided portions thereof are effected in writing, subject to the Minister's acceptance and to the payment of a transfer bonus of $4 for every square mile or fraction of a square mile."

Regulations Governing Use of Timber

Regulations as to the use of timber cut under license were adopted by the Quebec Government on April 26, 1910, which read:

> All timber cut on Crown lands after the first of May, 1910, must be manufactured in Canada—that is to say, converted into pulp or paper, deals or boards, or into any other article of trade or merchandise of which such timber is only the raw material. The following shall not be considered as manufactured within the meaning of the regulation: Timber simply cut into lengths, piled, barked, or otherwise worked preliminary to the manufacture of pulp or paper, deals or boards or any other articles of commerce.

New Brunswick passed similar legislation on April 26, 1911. There are no statutes prohibiting or regulating the export of pulpwood from Nova Scotia or British Columbia.

Freehold lands are not subject to the manufacturing clause restrictions, and wood cut on these lands may be exported or handled in any way that the owner sees fit.

Investigation on Pyrolytic Production of Phosphoric Acid

Briquetted Charge of Sand, Coke and Mine Run Hard Rock Phosphate Smelted in a Furnace Fired With Fuel Oil—Phosphoric Anhydride and Water Vapors Condensed in a Cottrell Precipitator, Giving an Acid Solution—Commercial Possibilities Shown

BY WILLIAM H. WAGGAMAN AND THOMAS B. TURLEY

FROM the standpoint of conservation the production of phosphoric acid by smelting mixtures of phosphate rock, sand and coke has always appeared particularly attractive, and since Ross, Carothers and Merz[1] pointed out the advantages and demonstrated the feasibility of collecting the fumes of phosphoric acid by means of the Cottrell precipitator the volatilization method of producing this acid has taken on an added interest. Not only is it possible to treat relatively low-grade phosphates by this method but the product obtained is sufficiently concentrated to admit of the expense of long freight hauls and heavy handling charges.

The furnace process of treating phosphate rock is by no means new, but is based upon the old method of making phosphorus. The scheme was proposed and patented in this country as far back as 1889[2] and more than twenty patents[3] have since been issued on devices and treatments designed to effect the nearly complete evolution of phosphoric acid from phosphate rock mixed with either sand or coke, or both. In most of these patents the arc furnace is the type stipulated as necessary to smelt the phosphatic charge and therefore it is generally believed that the complete volatilization of this acid from such mixtures can be brought about only under the conditions and at the temperatures attained in the electric furnace.

Fuel Versus Electric Smelting

The commercial feasibility of using the electric furnace for the production of phosphoric acid, however, appears somewhat dubious except where a pure product commanding a high price is desired. For fertilizer purposes pure phosphoric acid is not required and the cost of the product must be relatively low. Assuming that electric power might be available at $25 per hp.-yr., Carothers[4] in his report on the electric smelting of phosphates places the cost of P_2O_5 (exclusive of interest charges, taxes and depreciation) at 3.39c. per lb. Waggaman and Wagner[5] later showed that this cost might be materially reduced by using "mine run" phosphates instead of the more costly washed rock and employing the phosphoric acid produced therefrom to treat a fresh batch of the mineral, obtaining available phosphoric acid in the form of double superphosphate as the final product. But even under the most favorable conditions it is still an open question whether or not phosphoric acid for fertilizer purposes can be produced by the electric-furnace process at a price which will compete with that obtained by the sulphuric-acid method.

Since the electric furnace, however, performs no other function in this process than that of heating the charge to a temperature where phosphorus and phosphoric acid are readily evolved, and is simply a convenient form of apparatus to bring about the decomposition of the phosphate rock under reducing conditions, it seems evident that if these same conditions can be fulfilled by means of fuel in lieu of the electric arc a great saving in the cost of production should be effected.

The writers have found that practically the same results can be obtained at the temperatures attained in a fuel-fed furnace, and in the preliminary report[6] on this process data were presented showing that the nearly complete evolution of phosphoric acid from a phosphate mineral is perfectly feasible where gas or oil is used as the heating agent, provided reducing conditions are maintained until the mass is brought to a molten condition. From 60 to 98 per cent of phosphoric acid has been driven off from such mixtures by means of fuel in the laboratory, and similar yields were obtained by the use of a furnace holding about 200 lb. of charge. As the process finally developed, however, the furnace used in these larger-scale experiments proved to be poorly designed to handle the charge and the bulk of the slag produced did not show a volatilization of more than 63.2 per cent of P_2O_5. It was decided, therefore, to continue the work with more suitable equipment and under more favorable conditions.

It is recognized that the final proof of the value of this furnace process must rest in a plant of commercial size, but the funds were not available to construct such a plant, so a furnace of semi-commercial size with the auxiliary equipment for burning the combustible gases and collecting the phosphoric acid evolved was erected at Arlington Farm, Va., with a view to solving some of the numerous chemical and mechanical details involved and obtaining sufficient data to approximate the cost of producing phosphoric acid by this process.

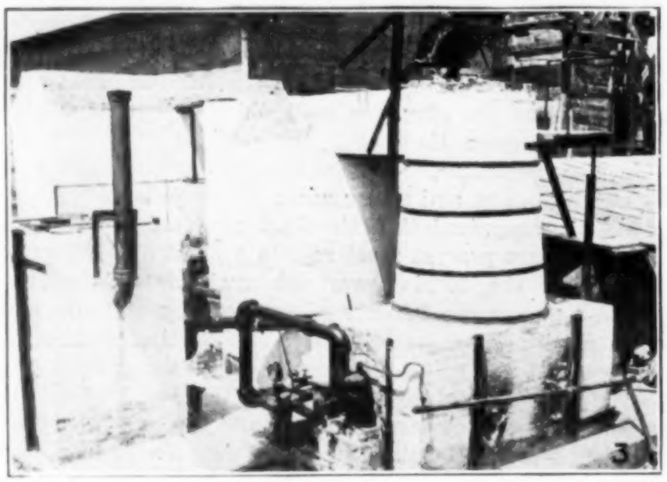
Considerable work yet remains to be done before the best type of furnace and equipment is finally established. Insufficient funds made it necessary to utilize much machinery and material illy adapted to the purpose and this fact, coupled with a very limited personnel, has made the problem a difficult one. The small size of the furnace employed has necessarily caused an enormous loss of heat units through radiation and the relatively short duration of the experimental runs has indicated a higher fuel consumption than would be shown in protracted tests. Nevertheless the results obtained are on the whole quite satisfactory and it is believed that the investigation has been carried to the point where the commercial feasibility of the process has been demonstrated and its ultimate economic success practically assured.

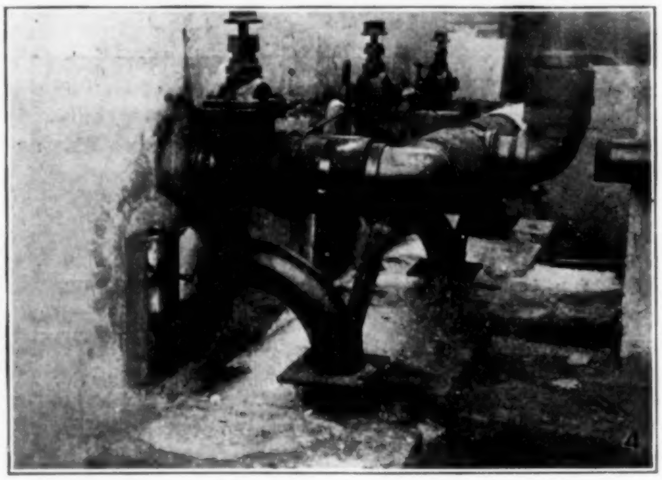
[1] *J. Ind. Eng. Chem.*, vol. 9 (1917), p. 6.
[2] U. S. Pat. 417,943 (1889).
[3] U. S. Pats. 452,821; 540,124; 669,271; 689,286; 709,438; 733,316; 862,092; 862,093; 984,769; 1,076,499; 1,044,957; 1,047,864; 1,018,186; 1,103,910; 1,112,211; 1,167,755; 1,173,960.
[4] *J. Ind. Eng. Chem.*, vol. 10 (1918), p. 35.
[5] *J. Ind. Eng. Chem.*, vol. 10 (1918), p. 353.

[6] Waggaman and Turley, *J. Ind. Eng. Chem.*, vol. 12 (1920), p. 646.

The firebrick furnace used in these experiments is a combination of the open-hearth and blast-furnace types and is heated by means of two oil burners, one at either end of an elongated slag chamber. This slag chamber is boat shaped and was originally 8 ft. in length, 9 in. in width (inside) at either end (where the oil burners are located) but widening to 20 in. in the center. In the center of the arched roof of this chamber is a circular opening leading up into a shaft or charge chamber 6 ft. in height and having the shape of the usual type of blast furnace. The throat of the chamber where it discharges onto the furnace hearth was 12 in. in diameter and widened out gradually until at the top of the bosh the internal diameter was 2 ft. From here on the walls of the chamber taper gently till at the top of the shaft the opening is only 14 in. in diameter. This chamber holds a total briquetted charge of 700 lb. One foot from the top of the furnace shaft is a 6-in. flue leading into the dust chamber. The walls of the furnace and slag chamber range from 13½ to 18 in. in thickness and were originally constructed entirely of firebrick.

After several preliminary runs with this furnace it was deemed wise to increase the length of the slag chamber in order to give the oil flame a better chance for combustion. Accordingly the furnace was extended 2 ft. at either end, giving a total length of 12 ft. It was also found that the heat attained was so close to the melting point of firebrick that it was necessary to replace them in part by carborundum brick, which stand satisfactorily the temperatures attained in the center of the furnace. In a larger installation, where adequate funds are available, the furnace would be cooled either by bronze plates inserted in the walls and through which water is kept circulating, or by some other convenient water-cooling device employed in blast-furnace practice. In Figs. 1 and 2 the furnace is shown in the course of construction and Fig. 3 is a view of the completed plant. The furnace proper is at the extreme right in these pictures.





FIGS. 1 AND 2. PROGRESS VIEWS OF CONSTRUCTION OF FURNACE
FIG. 3. COMPLETED FURNACE
FIG. 4. CONNECTION AT STOVES WHERE COMBUSTIBLE GASES FROM FURNACE ARE BURNED

OIL BURNERS AND OIL SUPPLY

The oil burners finally adopted for this furnace are manufactured by the Lalor Fuel Oil System Co., of Baltimore, Md. They operate with high-pressure oil (from 50 to 250 lb.), but use air at a relatively low pressure (4 to 8 oz.). The consumption of oil is controlled by the pressure and also by the size of the opening in the tips used. These burners have proved eminently satisfactory as long as the oil fed to them is thoroughly filtered. In order to prevent the ends of the burners from melting or getting too hot they are surrounded by steel water jackets set into each end of the furnace at an angle of about 60 deg. from the horizontal so that the oil flame plays upon the furnace hearth. These burners were designed to be placed several inches from the furnace opening and in addition to operating on the air furnished by a volume blower also utilize for combustion the air drawn in around the furnace opening. In this type of furnace, however, the air required to burn the fuel was preheated and entirely supplied through the air main from

the volume blowers. The burners operated very satisfactorily under these conditions.

A steel tank holding 500 gal. is used as the main reservoir for the fuel oil and this is connected with a small 80-gal. tank provided with a gage to measure the oil consumption. The oil is fed by gravity to a pump which forces it to the burners under a pressure of from 50 to 200 lb. The oil tanks are shown in Fig. 7.

Dust Catcher

The dust catcher into which the gases and fumes from the furnace pass was originally designed to act also as a preheater for the air supplying the oil burners and has an annular space surrounding the gas chamber. The use of the dust catcher, however, as a preheater was early abandoned because of the impracticability of rendering the wall between the air and gas chambers air-tight. A bleeder is located in the flue leading from the dust catcher to the stoves where samples of the furnace gases are withdrawn for analysis from time to time during a run.

Stoves

From the dust catcher the gases are led through sliding valves into the stoves, which are three in number. These stoves were intended, first, to burn the combustible gases evolved from the furnace, and second, to absorb the heat units thus produced by means of brick checkerwork; the heat thus absorbed being returned to the system by passing the air required for the oil burners through the heated checkers. The three stoves, however, were built together with a view to reducing radiation losses, and here also it was found impossible to render the common walls sufficiently tight to prevent the gases in one stove from mixing with the air passing through the adjoining one. The likelihood of thus causing an explosion rendered it necessary to abandon them as a means of heating the air to the oil burners. They are used, therefore, only to burn the combustible gases evolved from the furnace. From the stoves the gases are led through a 6-in. brick flue 25 ft. in length to the Cottrell electric precipitator, where the acid is collected. A monel metal exhaust fan placed in this flue serves to withdraw the gases from the furnace and discharge them into the precipitator pipes. The stoves are shown on the extreme left in Figs. 1 and 2, and in Fig. 4 the air and gas connections to the stoves can be seen.

Electric Precipitator

The electric precipitator used in this work was designed and built to handle the phosphoric acid evolved from an electric furnace. The electrical equipment has already been described by Ross, Carothers and Merz,[7] but the precipitator proper consists of six 6-in. terra cotta pipes, 12 ft. in length, under which is a stone basin to receive the acid dripping therefrom. The gases enter the precipitator through a 6-in. opening below this basin. Since this electric treater has been erected four years, several of the terra cotta pipes are now considerably out of plumb, making it impossible to center the wires hung in them. Much trouble was encountered due to the current arcing across to the sides of the pipes when a high voltage was employed. Not only is this precipitator located too far from the furnace but its capacity is too low to handle the quantity of phosphoric acid at the velocity with which it is evolved and discharged into the system. The precipitator proper is shown in Fig. 6 and the electrical equipment in Fig. 8.

Air Supply and Preheater

The air required for the oil burners is furnished by three Leiman positive pressure blowers, two of which have a capacity of 160 cu.ft. of free air per minute each, and the third a capacity of 360 cu.ft. When the furnace is in normal operation one large and one small blower are employed to supply the air. These discharge into a 4-in. steel main which is constricted at each burner to 3 in. in diameter.

Since the stoves could not be utilized to preheat the air furnished to the oil burners a preheater was built containing a coil of 60 ft. of 4-in. steel pipe heated by means of a small oil burner. During a furnace run pyrometers were located in the air main following the preheater, in the gas main leading from the dust catcher to the stoves, and in the flue leading from the stoves to the electric precipitator. The preheater is shown in the left foreground of Fig. 3.

Materials Used

The phosphate used in these experiments consisted of "mine run" material furnished by the Cummer Lumber Co., of Jacksonville, from hard rock phosphate mines near Newberry, Fla. As pointed out in the previous report[8] on this process, the "mine run" phosphates from these deposits usually contain sufficient phosphate to admit of their furnace treatment without being reinforced with higher grade rock[9]—in fact, in most cases sand must be added in order to

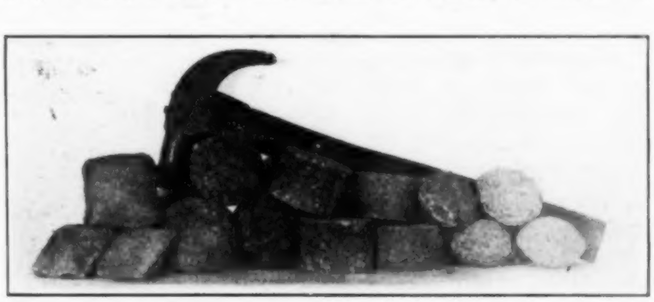


FIG. 5. FORMS OF BRIQUETS

obtain the proper silica-lime ratio (approximately 41 per cent CaO to 59 per cent SiO_2) to bring about the required reactions in the furnace. It has also been shown that these deposits contain considerable quantities of soft phosphate, a clay-like substance which acts as an excellent binder when the material is moistened and pressed into briquets. Such briquets will stand a drop of from 6 to 8 ft. upon a cement floor without shattering.

Two forms of briquets were used in the final experimental runs: The first in the shape of eggettes, 2 x 1½ x 1½ in., and the second in the form of pillows, 2 x 2 x 1½ in. The former shape has the advantage of having no sharp corners to sluff away, but the latter type does not pack so tightly in the furnace shaft and therefore allows a somewhat freer passage for the gases through the charge. While both forms of briquets worked quite satisfactorily in the furnace, showing no signs of cracking while being heated to

[7]*Loc. cit.*

[8]*Loc. cit.*

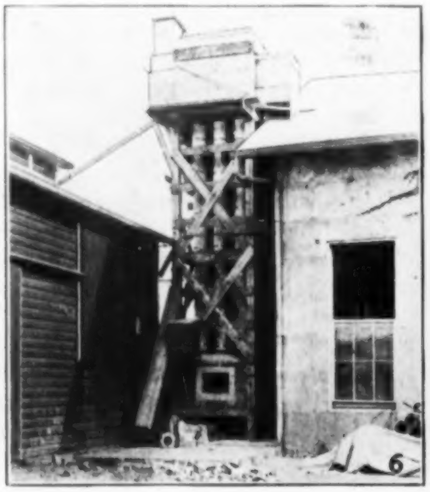
[9]The last batch of three tons of "mine run" phosphate, however, had to be reinforced with pebble phosphate.

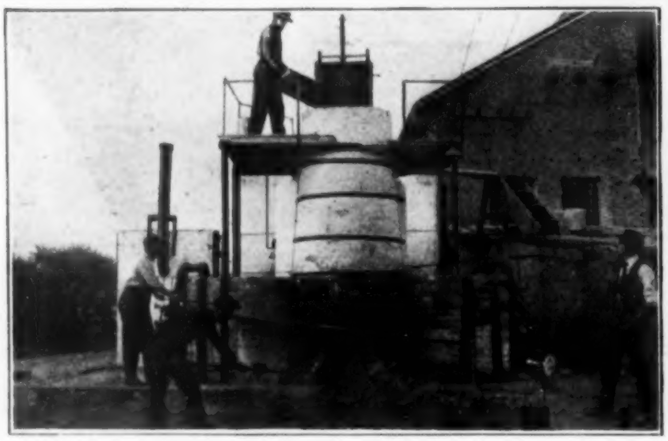
TABLE I. COMPOSITION OF BRIQUETTED CHARGE USED IN FURNACE EXPERIMENTS

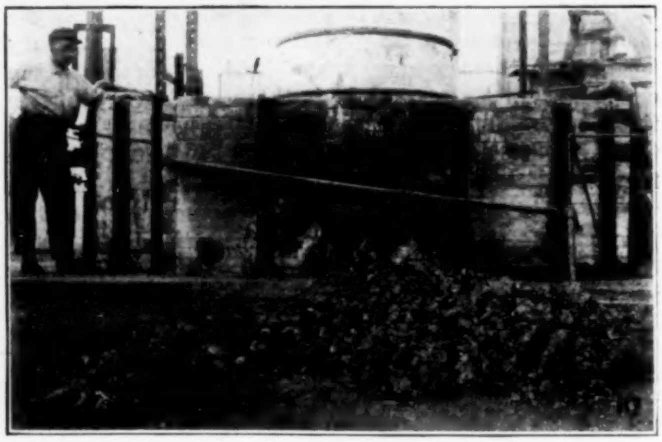
	Per Cent
Moisture	0.60
SiO_2	33.61
$Al_2O_3 \cdot Fe_2O_3$	6.71
CaO	24.67
MgO	not determined
P_2O_5	17.02
F_2	not determined
CO_2	1.29
C (contained in coke)	12.10
Total	96.00

Ratio of CaO to SiO_2 = 42 to 58.
P_2O_5 content exclusive of carbon and moisture = 19.99 per cent.

a smelting temperature, the pillow form is preferable where the briquets do not have to be shipped or handled too frequently. The various types of briquets used during the development of this process are shown in Fig. 5.







FIGS. 6 TO 10

Fig. 6. Electrical precipitator for collecting phosphoric vapors. Fig. 7. Fuel-oil tanks. Fig. 8. Generator, rectifier and transformer for precipitator current.

Figs. 9 and 10. Views of furnace and tapped slag.

The use of a briquetted charge was adopted in using the "mine run" phosphates of Florida for two reasons: First, the finely divided condition of these phosphates renders it essential to nodulize or briquet them before they can be handled in a plant of the blast-furnace type; and second, the necessity of maintaining reducing conditions until the mass has reached a smelting temperature. The latter requirement can be effectually fulfilled by incorporating coke in the briquetted charge.

The chemical composition of the briquets is shown in Table I.

Crude oil was used as the heating agent in these experiments. This oil was purchased in barrel lots both from the Texas Co. and the Standard Oil Co. and varied from time to time in viscosity and specific gravity. The average weight per gal. was 7.5 lb. and the calorific value was in the neighborhood of 19,000 B.t.u. per lb., or 142,500 B.t.u. per gal. Either crude oil or the residuum of petroleum can be used and there appears to be no reason why powdered coal burners should not be employed where this fuel can be obtained at a lower cost than oil.

Summary of the Last Two Runs of Furnace

Since the completion of the present type of oil-burning furnace at Arlington Farm, Va., with its auxiliary equipment for the collection of phosphoric acid, at least six tests have been conducted in smelting briquetted charges of "run of mine" rock from the Florida phosphate fields. These tests were conducted for periods of from six to twenty hours and the amounts of briquetted material charged ranged from 500 lb. to 1½ tons. While valuable data were obtained in practically all of these experimental runs, the furnace was in every instance except the last closed down before it was working at its maximum efficiency. In most cases the experiments were discontinued because of mechanical difficulties, which, however, were largely overcome in the last two tests. Only these last two runs therefore are recorded below.

At 8 a.m. on Oct. 6, 1920, the oil burners of the furnace were started and the first charge (50 lb.) of

briquetted material was added at 10: 45 a.m., when the furnace shaft was nearly full of coke and the air supply to the oil burners preheated to a temperature of 210 deg. C. The first charge was followed at intervals of from ten to fifteen minutes by additional charges of from 50 to 200 lb. of briquets, till at 12: 30 p.m., 1¾ hours later, a total of 650 lb. had been added. At this time the temperature of the air to the oil burners was 260 deg. C. and the fumes of phosphoric acid were being copiously evolved. The furnace shaft being then four-fifths full, the top was closed down, the exhaust fan started, and the current turned into the electrical precipitator. Twenty-five minutes later the acid was dripping from the basin below the precipitator pipes, the first half gallon being collected in thirty-five minutes and having a concentration of 15 per cent H_3PO_4. The exhaust fan used to draw the gas from the furnace, however, was not being run at sufficient speed to handle the volume of gas forced over from the furnace, so there was considerable back pressure at the stoves where the combustible gases were burned, which resulted in a large loss of phosphoric acid and caused the furnace to work rather irregularly.

At 1: 20 p.m. 400 lb. more of briquetted charge was added and twenty minutes later the furnace was tapped. It was found that the entire charge had worked through to the hearth and the viscous nature of the slag made it difficult to withdraw the partly smelted product. By increasing the oil pressure and the volume of air to the burners, however, the slag was rendered considerably more molten and was finally removed. During the next three hours 850 lb. of briquets was added. The top of the furnace was then closed and the slag holes were automatically plugged by allowing successive waves of the molten slag to flow forward and freeze at these openings.

One hour later (5: 20 p.m.) it was found that the entire charge (850 lb.) had completely worked through to the hearth, so 300 lb. more of briquets was added. At this time the air to the oil burners showed a temperature of 250 deg. C. and the gas entering the stoves showed a similar temperature—namely, 250 deg. C. The rate of consumption of the fuel at this time was only 9 gal. per hour for both burners. Twenty-five minutes later, or at 5: 45 p.m., the last charge (300 lb.) was also found to have smelted and worked through to the furnace hearth.

No further material was added, and at 6: 15 p.m., one-half hour later, an attempt was made to tap the furnace again, but owing to the fact that the slag had been allowed to accumulate and cool in the tapholes it was found impossible to break through to the molten mass within. The slag being at the level of the oil burners, it was necessary to close down. The phosphoric acid was flowing from the precipitator at the rate of 1½ gal. an hour, but the concentration was only 21 per cent of H_3PO_4. Analyses of the slag obtained after the furnace had cooled and was opened up showed a phosphoric acid content of from 7.99 to 13.63 per cent, or a volatilization of from 38 to 65.3 per cent of that originally in the charge.

The outstanding feature of this run was the rapid rate at which the material was reduced to a state of incipient fusion. No preparation was made to handle a large volume of slag in a limited time, and when this partly fused mass worked down through the furnace shaft, covering the slag already on the hearth, it seemed to cool the latter to the point where the evolution of phosphoric acid was much retarded. An analysis of the last slag produced, however, or that upon the surface, showed that over 52 per cent of the phosphoric acid was apparently evolved while the charge was being reduced to a state of fusion. In this particular instance the evolution was at the rate of about 80.5 lb. of P_2O_5 per hour, with a fuel consumption of 9½ gal. of oil, giving a yield of approximately 8.5 lb. of P_2O_5 per gal. of oil. The present selling price of soluble phosphoric acid for fertilizer purposes is 6¼c. per lb. The price of fuel oil in the Florida phosphate fields is in the neighborhood of 5c. per gal., so on this basis the cost of the fuel was 9.4 per cent of the value of the product. It was unfortunate that the furnace had to be closed down just at the time when it was heated to about the proper temperature to cause more rapid and complete evolution of the phosphoric acid, as a more protracted run would undoubtedly have yielded further valuable data. The highest temperature observed on the furnace during this run was about 1,500 deg. C., but no readings were made when the system was closed down.

THE SECOND TEST

Before undertaking the next test the throat of the furnace charge chamber was constricted from 12 to 9 in. in diameter in order to keep the charge from working down upon the hearth too rapidly. In addition to this a column or solid platform of carborundum brick was built under the mouth of this charge chamber to support the partly fused material being discharged therefrom and prevent its dropping directly into the more molten slag. The speed of the exhaust fan used in sucking the evolved gases through the stoves and precipitator was also increased so that the velocity of these gases in the 6-in. precipitator pipes reached seven linear feet per second. Since the precipitator was originally built to handle the phosphoric acid from an electric furnace where the velocity of the gases did not exceed three linear feet per second, it was expected that this incrase in speed would result in a great loss of P_2O_5.

This last experiment was begun at 8: 30 a.m. on Oct. 28, after having heated up the furnace the previous day with a charge of coke. The first charge of 100 lb. of briquets was added at noon and twenty minutes later phosphoric acid was being copiously evolved. This charge was followed by others of from 100 to 200 lb. each at intervals of from ten minutes to one-half hour until at 2: 15 p.m. 600 lb. had been charged. The furnace top was then closed and the exhaust fan started. At this time the air to the oil burners showed a temperature of 240 deg. C.

Fifteen minutes later, or at 2: 30 p.m., the current was turned into the electrical precipitator and here trouble developed almost immediately. It was found that one of the precipitator pipes was so badly buckled that it was impossible to center the wire sufficiently well to prevent the current from arcing across to the side. In spite of the fact that the precipitator was working only intermittently a small stream of acid was flowing from the basin within fifteen minutes. At 3 o'clock, however, it was decided to shut off the precipitator entirely, as the trouble grew steadily worse. The furnace was tapped for the first time at 3 p.m. and owing to the difficulty experienced in removing the slag and residual coke the tap-holes were left open until

4: 20 p.m., or one and one-half hours. During this time 800 lb. more of briquetted charge was added. The average slag obtained from this first tap showed a content of 10.72 per cent P_2O_5, or a volatilization of only 52.0 per cent of that originally present. A sample of more liquid slag dripping from the charge chamber upon the hearth and withdrawn from the furnace just before the tap-holes were closed showed also a content of 10.72 per cent P_2O_5.

This seems to bear out the conclusions reached in the first tests that approximately one-half of the phosphoric acid was evolved quite rapidly during the fusion of the mass. At 5: 35 p.m. 150 lb. more of briquets was added, making a total of 950 lb. since the tapping of the furnace was begun. The furnace top was closed down and the gas again passed through the precipitator. Apparently the charge worked down to the furnace hearth quite rapidly, for at 6 p.m., when an analysis was made of these gases, they showed only 1.20 per cent of PH_3 and 4 per cent of CO. These gases were not sufficiently combustible to burn at the stoves.

At 6: 30 p.m. the furnace was again tapped. The slag was also similar to that obtained in the first instance, but showed upon analysis 12.08 per cent of P_2O_5, or a volatilization of only 45.03 per cent. Both the furnace top and slag holes were left open until 9: 30 p.m., during which time 600 lb. of material was charged and the temperature of the air supplying the oil burners rose to 350 deg. C. At this time it was decided to cut out the faulty pipe in the electrical precipitator. This, of course, resulted in increasing the velocity of the gases in the remaining five pipes to 8.4 linear feet per second, but the precipitation of acid was much improved. The slag holes were then closed, the top of the furnace was lowered, and at 9: 45 p.m. the current was again thrown on the precipitator.

While this apparatus was unable to collect more than one-third of the P_2O_5 passing through it, a stream of dilute acid was soon flowing from the basin below the pipes at the rate of ½ gal. in eighteen minutes. The concentration of the acid collected steadily rose as the temperature of the gases from the stoves increased from 100 to 145 deg. C. The first bottle (½ gal.) showed a concentration of 19.28 per cent H_3PO_4; the second bottle 21.5 per cent; the third 21 per cent; the fourth 23 per cent; the fifth 31 per cent; the sixth 41 per cent; and the seventh 60 per cent. The last runnings showed a concentration of 64 per cent H_3PO_4. Had it been possible to continue the test longer the strength of the acid would no doubt have reached 80 to 90 per cent.

No more briquets were added until 11: 10 p.m., when it was found that the charge chamber was completely empty. Then 400 lb. was added, but it ran through to the hearth almost immediately. At this time the temperature of the air to the oil burners had dropped to 325 deg. C., but the temperature of the gases to the stoves had risen to 300 deg. C., showing that there was practically no green charge in the shaft to absorb the heat units from the gases. On analysis these volatile products showed only about 6½ per cent of combustible gases, exclusive of the phosphorus. This quantity was insufficient to cause the gases to burn. One hour later, however, it seemed apparent that the furnace was operating at its highest efficiency and therefore it was decided to charge all of the remaining briquets and fill the furnace shaft to the flue. Accordingly 950 lb. was added between 12: 15 a.m. and 1: 14 a.m., Oct. 29. Fifteen minutes after the last addition of briquets the gases from the furnace were analyzed and showed the following composition:

	Per Cent		Per Cent
PH_3	2.2	O_2	0.2
CO_2	7.7	CO	13.8

These gases were able to support combustion and burned quietly at the stoves, increasing the temperature of the P_2O_5 going to the precipitator and also the strength of the acid collected. It was found at this time that the oil pressure, and therefore the amount consumed, could also be considerably lowered without cooling the furnace, and the rate of consumption was finally reduced to 8.3 gal. per hour for both burners. The furnace was allowed to run until 4 a.m., when it was again tapped and this time a very molten slag was obtained which continued to flow from the furnace in a steady stream for about one-half hour. Upon cooling this slag exhibited the characteristics of a brittle glass and ranged in color from grayish green to dark blue. Analysis of average samples of this slag are shown in Table II.

TABLE II. PHOSPHORIC ACID CONTENT OF FINAL SLAG PRODUCED IN FURNACE RUN AND PERCENTAGE OF VOLATILIZATION OBTAINED

Sample No.	Description of Slag	Content of P_2O_5 Per Cent	Amount of P_2O_5 Volatilized Per Cent
4d	Bluish black, very glassy (1st runnings)	0.56	97.75
5d	Dark gray to green, very glassy (2nd runnings)	0.76	96.95
6d	Dark gray to green, very glassy (last runnings)	1.00	96.00
Average slag		0.77	96.90

The average phosphoric acid content of this final slag, as will be noted, was 0.77 per cent, which means that nearly 97 per cent of the acid present in the original charge was volatilized. This elimination of acid from the slag is about as complete as that obtained by the use of the electric furnace for the same purpose.

Yield and Cost of Product

It is rather difficult to arrive at a fair figure showing the yield of acid (P_2O_5) per gal. of fuel oil consumed in a test of such short duration, particularly when the furnace was not functioning at its best until the latter part of the run. It seems fair, however, to take the rate of fuel consumption during the last two hours of the run, when the furnace attained its maximum temperature (between 1,500 and 1,600 deg. C.) as that at which the oil could be fed to the burners had it been possible to conduct the experiment for a longer period. During the last 3½ hours of the test 950 lb. of briquets was charged into the furnace shaft and completely reduced to a molten slag with the evolution of 161.9 lb. of phosphoric acid (P_2O_5), or 96.90 per cent of that present in the original mass. The amount of oil consumed (at the rate of 8.3 gal. per hour) in driving off this acid was 29.15 gal. This gives a yield of 5.56 lb. of P_2O_5 per gal. of fuel. At the present price of oil and phosphoric acid given above the cost of the fuel consumed was 14.4 per cent of the value of the product for fertilizer purposes. It will be noticed, however, that the cost of fuel per lb. of acid produced appears actually higher than that obtained in the previous furnace run when the volatilization of acid was

much less complete. Probably better figures would have been obtained had the furnace been tapped earlier, as the acid may have been largely eliminated from the slag long before the latter was run out of the furnace. There is certainly little doubt, however, that in a prolonged test with a larger furnace a much lower fuel consumption per lb. of acid produced would result.

Yet even on the basis of these figures this process appears economically superior to the present method of producing soluble phosphates for fertilizer purposes. In manufacturing acid phosphate, for instance, sulphuric acid is used as the reagent and the cost of this acid represents at least 23 per cent of the value of the product. In the furnace process, on the other hand, fuel oil is the reagent used and even with the small and admittedly inefficient experimental plant the cost of fuel oil required to bring about the desired reactions was less than 15 per cent of the value of the product. To the cost of the fuel oil there must also be added, however, the price of the coke incorporated in the briquets, but this does not appreciably increase the expense of treatment.

TABLE III. AMOUNTS AND COST OF MINE RUN PHOSPHATE AND COKE BREEZE REQUIRED PER TON OF PHOSPHORIC ACID, AND COST OF BRIQUETTING THIS MIXTURE FOR FURNACE TREATMENT

Charge and Its Manipulation for Furnace Treatment	Quantity Lb.	Cost per Ton of Material	Cost per Ton of P_2O_5
Mine run phosphate and sand	10,542	....	....
Mining	10,542	$1.00	$4.70
Drying	10,542	0.50	2.35
Grinding	10,542	0.50	2.35
Coke Breeze	1,438	8.00	5.14
Grinding	1,438	0.50	0.32
Mixing and briquetting	11,990	1.25	6.69
Total		11.75	21.55

In Table III the estimated cost of preparing the briquetted charge for furnace treatment is given, and in Table IV is shown the approximate cost of producing phosphoric acid by the furnace process in a plant capable of turning out thirty tons per day of twenty-four hours. While some of the cost items are based on the data gathered in the runs of the experimental furnace at Arlington, Va., others are estimated or based on estimates received on the cost of building a larger plant. This plant would comprise the furnace and auxiliary equipment, including the electric precipitator and also grinding and briquetting machinery, storage bins, a mixer, drier, etc. The costs are also based on the assumption that the plant would be located in the Florida phosphate fields.

TABLE IV. COST PER TON OF PHOSPHORIC ACID (P_2O_5) 90 PER CENT YIELD, PRODUCED BY SMELTING A "RUN OF MINE" PHOSPHATE IN AN OIL-BURNING FURNACE

Daily Output 30 Tons of P_2O_5	
Briquetted material	$21.55
Fuel oil, 360 gal. @ 5c. per gal	18.00
Power	3.50
Interest on $75,000 @ 6 per cent	0.41
Depreciation on $75,000 @ 20 per cent	1.37
Labor — 18 men at $5 per day	3.00
Insurance	0.50
Overhead expenses	1.50
Total	$49.83

Even in making the most liberal allowances for the various items of expense the total cost of manufacturing phosphoric acid by the furnace process amounts to only $49.83 per ton, or 2.49c. per lb., as against the present selling price of 6.25c. per lb.

It is interesting to compare this cost with that of producing a ton of phosphoric acid in the form of acid phosphate. In Table V is shown the average cost of this commodity as given by three large manufacturers.

TABLE V. AVERAGE COST OF PHOSPHORIC ACID (P_2O_5) PER TON IN THE FORM OF ACID PHOSPHATE

Phosphate rock, 6,250 lb. @ $7.60 per ton	$23.75
Sulphuric acid, 6,250 lb. @ $9.50 per ton	29.69
Shrinkage., 6,250 lb	6.56
Labor	6.25
Power	5.00
Depreciation	2.50
Overhead, insurance, taxes	7.50
Total	$81.25

Under the most favorable conditions the present cost of producing phosphoric acid in the form of acid phosphate is $81.25 per ton, or 4.6c. per lb. Many manufacturers claim their cost of production is considerably higher than this figure.

On the basis of the data so far obtained, therefore, the cost of manufacturing phosphoric acid by the furnace method should be little more than one-half of that of producing it by the sulphuric acid process. When we take into consideration also the facts that by using the smelting process a concentrated product would be obtained which can stand heavy transportation and handling charges and that the life of the phosphate deposits would be greatly prolonged because the waste of low-grade phosphates would be largely eliminated the future of this process appears very promising indeed.

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Vanadium*

BY FRANK L. HESS

THE minerals of vanadium are the sulphide, patronite; the oxidation products, vanadinite, descloizite, dechenite, psittacinite and related minerals found in the oxidized parts of lead and copper veins, carnotite and roscoelite (a vanadium mica). It is also present in unknown form and small fractions of 1 per cent in ilmenite, some asphaltites and some iron ores, such as the minette ores of northeastern France and other iron ores of France.

Patronite, now the most important vanadium ore, furnishing probably two-thirds of the world's vanadium, is found at only one place, Minasragra, Peru, where it occurs in a single mass of asphaltic material with a roughly lenticular horizontal section in sedimentary rocks. The depth to which it extends is unknown. Carnotite is found in this country in flat-lying soft sandstone beds, as a deposit formed by the replacement of wood or other vegetable remains, now fossilized, and as material impregnating the sandstone. Roscoelite occurs as a thin flat vein and as an impregnation in flat-lying sandstone near Placerville and Vanadium, Col.

Many ilmenites, segregations from igneous rocks, carry a small fraction of 1 per cent of vanadium but have not yet been worked for vanadium.

IMPORTS

Vanadium ore imported during the last six months of 1918 amounted to 1,772,215 lb., valued at $5,333. No separate record was kept prior to July, 1918.

*Advance sheets, Mineral Resources of the U. S., 1918.

The United States, as the largest steel-making nation, is the largest user of vanadium. England, Germany and France buy ferrovanadium from this country and also buy ores when possible.

The Minasragra deposit is owned by an American company, the American Vanadium Co., but of course the political control is wholly in the hands of Peru.

The exports from Peru and the production in the United States since 1912 have been as shown in the accompanying table.

APPROXIMATE WORLD'S PRODUCTION OF VANADIUM, 1912-1918

Year	Peru (ore) Quantity (Short Tons)	Peru (ore) Percentage of V_2O_5	Peru (ore) Vanadium Contained (Short Tons)	United States (ore and concentrates). Vanadium Contained (Short Tons)
1912	3,048	45.00	758	300
1913	None	.....	...	432
1914	14.5	45.00	4	452
1915	3,145	45.58	803	627
1916	3,448	40.00	772	460
1917	4,083	35.78	821	484
1918	2,183	19.10	234	276

TECHNOLOGY

In a general way the sulphide patronite is roasted and fused with a soda salt to form sodium vanadate, which after extraction is smelted in an electric furnace to ferrovanadium carrying between 35 and 40 per cent of vanadium.

The vanadates of lead, coppe1 and zinc are commonly fused with a soda salt, the lead separating as metal and the vanadium going into the slag as sodium vanadate, from which point the general process is the same as for patronite.

In the treatment of carnotite for radium, vanadium is separated as oxide or iron vanadate, which is reduced in the electric furnace to ferrovanadium.

Roscoelite-bearing sandstone is roasted with salt and pyrite, lixiviated, filter-pressed, the solution treated with a ferric salt to precipitate the vanadium, the precipitate filtered out, and the ferric vanadate smelted in an electric furnace to ferrovanadium.

Some asphaltite has been burned in Peru and the ash shipped to the United States for treatment, presumably by fusing with soda, and so on.

In smelting the minette ores of France, the vanadium is carried into the slag and is extracted from that.

USES

The one use that makes vanadium of large economic value is as a scavenger and alloy in steel. Added to steels in quantities of 0.25 to 1.50 per cent, it is said to remove occluded oxygen and nitrogen and also to combine with the steel. In the smaller quantities, it is said to give great toughness and is used in steels for automobile axles and other parts on which severe strains come, for locomotive tires and frames and in similar steels. The larger quantities are used in high-speed and other tool steels. Its use is now as standard as that of tungsten in high-speed steels. Small quantities of vanadium have been used in dyes and medicines, and still smaller quantities for other purposes.

In the manufacture of steel, efforts are now being made to use molybdenum as a toughener and titanium as a scavenger as substitutes for vanadium, but these substitutes are not common. Titanium has been used in cast steels, though not with entire success.

Active or Available Chlorine

BY J. R. MACMILLAN*

Although the following notes may seem to cover the simplest form of chemistry, the writer has encountered some peculiar ideas concerning the principles involved.

The term "active" or "available" chlorine is used to define the chlorine in bleaching powder that has oxidizing power, to distinguish this from the chlorine present in the form of chlorides or chlorates. It is the usual practice in routine analysis of bleaching powder to determine the active chlorine and also the total chlorine present. The difference in percentage between the active and total chlorine is called chloride chlorine or inert chlorine. Thus good bleaching powder may test:

	Per Cent
Active chlorine	37.5
Total chlorine	38.1
Chloride chlorine	0.6

while decomposed bleaching powder may test

	Per Cent
Active chlorine	29.5
Total chlorine	36.5
Chloride chlorine	7.0

If bleaching powder could be made under ideal conditions, the percentage of active and total chlorine would be the same.

When bleaching powder is dissolved, however, the term "active" chlorine becomes somewhat of a misnomer, as the active principle then is the oxygen in the calcium hypochlorite. However, as two atoms of chlorine are required to react to place one atom of oxygen in calcium hypochlorite, the results, if this is understood, are expressed correctly either in terms of chlorine or oxygen. The same is true when chlorine is absorbed in alkaline solutions or in milk of lime. If conditions as to temperature and distribution of gas are properly maintained, all of the chlorine absorbed will be indicated by analyses to be "active," although only one-half of it will be present in the hypochlorite formed. For instance, consider the reactions

$$2NaOH + Cl_2 = NaClO + NaCl + H_2O$$
$$2Ca(OH)_2 + 2Cl_2 = Ca(ClO)_2 + CaCl_2 + H_2O$$

Thus a pound of chlorine gas is equivalent to a pound of active chlorine in bleaching powder.

If some of the chlorine present in the form of chloride, according to these reactions, can be removed from the solution, then it is possible to get an analytical result showing a higher percentage of "active" chlorine than the percentage of total chlorine present. This is possible because the oxidizing power of the solution is really what is determined, although it is expressed in terms of chlorine. This condition can be demonstrated by passing chlorine slowly into strong, well-cooled caustic soda solution of say 40 per cent strength, and filtering off the salt crystals that form.

These statements are offered with the hope that they may be of assistance to some, as the following opinions have been encountered a number of times: First, that when chlorine is absorbed in an alkaline solution, only one-half of it can be "active," because the other half forms chlorides; second, that since, in a properly prepared solution made from chlorine and an alkali, the percentages of active and total chlorine as determined are equal, while only one-half of the chlorine is present in the hypochlorite formed, an efficiency of 200 per cent is attained in some unexplained manner.

A careful study of the valences involved will indicate the fallacy of both of these views.

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Process and Equipment for Refining Benzene Hydrocarbons

A Detailed Discussion of Benzene Washer Construction—Materials of Construction: Cast Iron, Wrought Iron, Riveted and Welded, Sectional Plates, and Lead—Design of Body—Types of Agitators

BY A. THAU*

NEARLY all modern benzene works are now arranged so as to be able to supply pure or washed products complying with the trade specifications, and in the design of the benzene plants such perfection has been reached during recent years that the consumers are content to buy the finished products instead of taking the crudes and purifying them at their own plants.

The purifying of the benzene products is, with suitable plant and properly trained men in charge, not a difficult task; but the most troublesome piece of apparatus in a benzene plant is undoubtedly the washer, in which the products are brought into intimate contact with different washing mediums, the effect of which is to take up and remove certain impurities from the benzene hydrocarbons which would otherwise impair their purity.

Washing Light Oil Direct

The crude benzene hydrocarbons are transferred into the washer, consisting of a vertical cylindrical vessel which they fill to only such a height that ample room remains for the addition of the respective washing mediums. When the benzene industry was comparatively young, the crude benzene or light oil distilled off the wash oil in the first stage, having a strength of 55 to 65 per cent, was accumulated and treated directly in the washer. There are a number of plants at work yet practicing this old wasteful method, which causes a great loss of both benzene and washing acid. In all modern plants the light oil is redistilled and divided into two or more fractions. A comparatively great amount of residue is recovered at the same time, consisting mainly of wash oil and naphthalene, which, though not of great value in itself, facilitates the washing process considerably by its absence and is responsible for great economy by reduced acid consumption and benzene losses compared with the first-mentioned method.

Intermittent Redistilling

The recently built, large benzene plants can, according to their working methods, be divided into two classes. In the one, forming the majority, the light oil is transferred into a retort still having the form of a large horizontal boiler, carrying in place of the dome a high fractionating column. The light oil is distilled and the products fractionated according to their boiling point, conducted to different collecting tanks and each fraction is washed and finally redistilled separately as soon as a sufficient quantity of the respective product has been accumulated. The light oil is by this method redistilled in an intermittent process, after the conclusion of which the residue, consisting of wash oil with naphthalene in solution, is transferred to a crystallizing pan, in which the naphthalene settles and the wash oil can be decanted off.

Continuous Redistilling

The above-mentioned second method in redistilling light oil owes its existence to the efforts to make the whole benzene plant a continuously working process. These efforts have so far been crowned with success that it has been possible to make the whole distilling of the crude products continuously working—that is, up to the point where they must be subjected to washing. In the continuous redistilling of the light oil by this method, two fractions are obtained, a larger one consisting of 90 per cent benzene and a smaller one consisting of those hydrocarbons which have a higher boiling point than benzene. The residue runs off continuously in a thin stream conducted into a crystallizing pan.

Continuous Fractionating

Although it is not intended to go fully into detail in this article as to the comparative merits of these two methods, it may appear to be disadvantageous to obtain only two fractions, making a further fractionating during the final distillation compulsory. Some benzene plant constructors claim to be able to provide continuous working stills yielding any desired number of fractions, but even at its best, these fractions are so roughly separated that a further close fractionating will be necessary during the final distilling. A splitting up in more than two fractions makes a continuous working still rather complicated and requires very close attention in maintaining certain temperatures.

Two Fractions While Redistilling

From a practical point of view, especially in consideration of the washing process, dividing into more than two fractions is not an advantage, particularly as even with a very close fractionating of the crude products in the intermittent process a further, though slight, fractionating during the finishing distillation cannot altogether be avoided. The division of the crude products into two fractions simplifies the plant in that only two store tanks for the intermediate products are required, while such a plant is at a disadvantage in being unable to allow the sale of crude toluene, xylene, solvent naphtha, heavy benzene, etc. The demand of those products in the crude state is, however, limited.

Methods of Washing Different Fractions

Thus, in washing crude benzene hydrocarbons, there are, depending upon the arrangement of the plant, three different possibilities: 1, The light oil is washed

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without redistilling. 2. The light oil is redistilled intermittently and split up in a number of distinct fractions which differ from the finished products only in that they contain chemical and mechanical impurities. 3. The light oil is, in continuous working stills, redistilled and separated in two fractions—viz., 90 per cent benzene, and hydrocarbons with a higher boiling point than benzene. Of course by the arrangement of the plant according to the second method it is also possible to divide the products into two fractions as in the third method, although this is rarely done.

As already mentioned, the first of these methods, though still practiced in a few old plants, is antiquated and too wasteful to be worthy of further consideration in this connection.

Washing Particular Fractions

In a plant using method 2 or 3 there is the 90 per cent benzene to be treated by itself in the washer. The specific gravity of the crude benzene is about 0.88, that of the respective washing medium—viz., sulphuric acid, water and alkaline lye—1.8, 1.0 and 1.15 respectively. It is thus evident that a considerable difference exists between the specific gravity of benzene and the respective washing medium with which it is treated, and as in the washing of benzene not much heat is developed, the two fluids do not mix readily, but separate easily. The same remarks apply to the next fraction—viz., toluene—though the temperature when mixing the acid with the toluene is raised somewhat higher than in the case of benzene. Coming to the last separately obtained crude fraction, the solvent naphtha, such a heat is set up by the reaction of the acid and the lye upon the hydrocarbons that a temperature approaching the boiling point of water is frequently reached. Taking into consideration that, in the case of a liquid, specific gravity means density, it will be quite apparent that an increase of temperature considerably facilitates the mixing of the liquids and jeopardizes their separating after washing. These facts make the treatment of solvent naphtha in the washer difficult and wasteful. Solvent naphtha forms with acid and lye an intimate mixture which can justly be called an emulsion. Once an intimate contact is reached between solvent naphtha and acid or lye, its temperature is raised so much that a settling and draining of the washing medium can be effected only after the lapse of a considerable time, during which the contents of the washer have somewhat cooled down. It must, however, be understood that the difference in specific gravity between solvent naphtha and the respective washing medium is for practical purposes equally as great as in the case of benzene and the washing medium, the only difference being that the washing medium acts quickly upon benzene, generating little reactionary heat, while with solvent naphtha the action is much slower. The temperature, however, is raised to a much higher degree, thereby balancing the former difference in specific gravity (or, better expressed, density) and facilitating the formation of an emulsion which even when cooled down will not dissociate completely. The washing medium drained off the solvent naphtha contains thus always a great proportion of hydrocarbons, and this is mainly responsible for the great losses in treating this faction, which amount to 30-40 per cent at its best, not taking into account the time spent, which, to obtain a fair separating after the washing, may cover even several days.

It will thus be readily understood that method 3, by which only two fractions have to be treated, has its advantages as far as the washing is concerned, while greater attention must be paid to the final distilling to obtain the proper fractions. The care necessary to be taken thereby cannot be called a disadvantage, as it does not entail extra cost for heat or labor and with a little skill the fractions can be separated with equal precision as if they had been fractionated before.

By splitting the light oil in two fractions, benzene and heavy hydrocarbons, while redistilling it, the latter consist approximately two-thirds of toluene and xylene and one-third solvent naphtha and still heavier compounds. Naturally such a compound fraction is more easily and quickly washed than if the solvent naphtha were treated by itself, though I have not been able to get any evidence that the washing losses are proportionately smaller. From the amount of liquid hydrocarbons in both cases, I am inclined to believe that the losses of solvent naphtha are in both washing methods proportionately equal. It is thus apparent that too close fractionating in redistilling the light oil is not an advantage.

Means and Effects of Washing

Without going into detail as to the actions taking place between hydrocarbons and washing medium, it may be said that the acid precipitates the greatest part of the impurities, which coagulate to a tarry consistency while warm, and in the colder state become of a pitchy nature and may even form lumps if not withdrawn quickly. In the heavier hydrocarbons some of the impurities are polymerized and remain in solution. They are recovered as residue in the still after the liquid hydrocarbons are driven off and can be evaporated to any desired consistency by vacuum distillation, forming the slightly transparent cumaron resin.

A certain amount of acid is retained by the hydrocarbons in the washer, which would be detrimental to their further use and injure the apparatus in which they are subjected to final distillation. To neutralize these remains of acid the hydrocarbons are equally intimately mixed with an alkaline lye; caustic soda lye at a density of 1.15 is probably the best. Ordinary washing soda or milk of lime is applied in some plants for the same purpose. Washing soda has the disadvantage of greater bulk. Soda lyes have the advantages over milk of lime that a smaller quantity need be applied in proportion to the effect, that no stirring arrangements are required to keep the alkali in suspension and that the whole method of application is much cleaner and more easily controlled.

As it would be a waste of alkali to neutralize all the acid which remains mechanically mixed with the hydrocarbons, these receive a preliminary washing with water, which removes a great proportion of the acid, and only those particles which are intimately mixed with the hydrocarbons and held in close suspension need be neutralized afterward. By this intermediate washing with water, the consumption of alkali is reduced considerably, no excessive reactionary heat is created and boiling over of the contents in the washer is prevented.

Re-using Sulphuric Acid for Washing

In many, perhaps in most, modern plants provision is made to run the sulphuric acid which may have been used for a second or third washing into a specially provided store tank, from which it can be transferred to

the benzene washer again for further use later on. Appealing as this arrangement may seem from an economic standpoint, it is of little use in practice and if employed is generally the cause of more bother than economy owing to the impurities obstructing the connecting pipes and settling in the collecting tank. As all the acid used for washing benzene hydrocarbons is in any case regenerated and worked up in the manufacture of sulphate of ammonia, it is better not to take any risks as to the possibility of being able to apply the once-used acid a second time.

Arrangement of Washing Apparatus

As will be gathered from the foregoing remarks, the washing apparatus must be of suitable design to induce a very rapid mixing and intimate contact between hydrocarbons and the respective washing medium and also must facilitate an easy settlement and separation of the two fluids afterward.

The position of the washer in the benzene plant must be elevated so that the used acid, decanted off at the bottom outlet, can run by gravity to a regenerating plant and so that the washed hydrocarbons can, also by gravity, be transferred to the finishing still.

Capacity of Washer

The washer body consists of a vertical cylinder, and its capacity must be such as to be in direct proportion to that of the finishing still, or where the latter is much greater the washer capacity may be one-half or one-third that of the finishing still. In all cases the proportion to the capacity must be such that the washer can be emptied completely into the finishing still. As the latter cannot be filled to the top, some free space must be left above the surface of the liquid.

Material of Washer—Cast Iron

The washer is made either of cast or of wrought iron. If of the latter, it must be lead lined. The objection against cast iron is the great weight, making a very strong and substantial substructure necessary to carry the whole apparatus. The difference in weight between a good lead-lined wrought-iron washer and one of bare cast iron of $1\frac{1}{2}$ to 2-in. thickness is, however, not so very large. The rule has been in recent years to employ bare cast iron of about $1\frac{3}{4}$-in. thickness and use it till the effect of the acid makes itself felt by a number of irregular holes eaten in the shell. The washer is then lined with sheet lead of $\frac{1}{2}$ to $\frac{5}{8}$-in. thickness fastened by cutting out pieces corresponding with the holes eaten in the shell. The cut-out pieces are then run full of lead, which fills the holes in the shell and gives the lining a hold in as many places as possible.

Even under most favorable conditions the difference in price between sheet lead and cast iron is so great that the writer has found it more economical to calk holes eaten through the shell with soft lead. After the apparatus gets too highly depreciated it is replaced. In the long run it is cheaper than lead lining it, unless one gets a casting with a number of bad sand holes.

Wrought Iron, Riveted

A fabricated wrought-iron washer must be lead lined, otherwise the acid will dissolve the iron scale around the rivets,* which then become loose and leak almost immediately. To enable the lining to be placed evenly into the shell, the rivets must be countersunk on the inside. Through numerous holes drilled into the shell, lead rivets are driven to which the lining is attached by burning while the rivets are knocked flat on the outside of the shell. As there is a great difference in the expansion coefficient of lead as compared with wrought iron, the iron expanding and contracting with temperature more than lead, the use of lead-lined wrought-iron receptacles cannot be recommended at all in cases where temperature variations are had as in a benzene washer.

Wrought Iron, Welded

If wrought iron is employed as material for the washer shell, only a cylinder with autogenously welded seam should be selected for the purpose and this covered inside homogeneously with a coating of lead about $\frac{1}{2}$ in. thick. Such a washer is preferable, even compared with one of cast iron, but its price is several times higher. While in the case of wrought iron the shell can be made of one single length, there are generally two or three pieces flanged together in a cast-iron washer.

Sectional Plates, Lined

There is a method of constructing washers of wrought- or cast-iron sections with horizontal and vertical flanges. The edges of the corresponding lead sheets are caught between these flanges, which are then bolted together tightly. Such washers last just as long as homogeneously lead-covered ones, if the single sections do not have too large surface dimensions. However, the large number of joints inside the washer give acid and impurities places for lodging and thus make clean washing almost impossible.

Lead Lining

With lead-lined washers, the trouble caused by expansion makes itself felt. The lead sheeting gradually loses its elasticity. If not fastened over an area greater than 12 sq.in., it begins to bulge and warp. Then after a short time it will crack just over the bulges. In exceptionally bad cases the whole lining has dropped to the bottom of the washer because it had not been fastened in a sufficient number of places or over the necessary area. This trouble is avoided with washers built in sections that are flanged and bolted in both directions as well as with homogeneously lead-covered ones, because cast iron does not expand and contract as much as wrought iron. Also, owing to the greater thickness of a cast-iron shell, it is quite obvious that a lead-lined cast-iron washer will last longer than a wrought-iron one.

Top of Washer

The top of the washer ends in a flange to which a lid is bolted, on which in most cases the gear and bearing for the internal stirring arrangement are mounted. The lid is provided with several openings, one in the center through which the shaft of the stirrer is introduced, one manhole with loose removable lid for inspection and several pipe openings for the introduction of the benzene hydrocarbons, acid and alkali respectively.

Shape of Washer

The design of the washer, the shape of its bottom and in particular the stirring arrangements are briefly described by a number of sketches of which Fig. 1 shows the simplest form in use.

*Editor's Note: American practice overcomes this difficulty by fusing the edges of the rivets and calked joints electrothermally. Oxide, to be sure, is included, but the acid is prevented from working under the rivet head.

This washer is built up of three cylindrical flanged sections of cast iron. To the top flange a lid is bolted, which supports on two bracket bearings a horizontal shaft with fast and loose pulley at the end. The driving shaft is geared by a pair of cog wheels at the center of the lid to the vertical stirrer shaft, which is suspended freely from the lid and supported by means of ball bearings. At the bottom end an ordinary propeller is keyed to the shaft so that it will agitate the contents of the washer when revolving. The bottom section of the washer tapers in funnel shape into an outlet branch with flange. The arrangement shown in Fig. 1 of supporting the washer by vertical columns or joints is rather an exception now. To make the bottom connections of the washer as short as possible and easily accessible, modern washers are provided with brackets on the shell which rest on a horizontal girder frame. This may be placed in a corner of the building so that three sides of the frame are supported by the walls of the building and the fourth by a column. The shape of the bottom shown in Fig. 1 has in its steep taper the disadvantage that the heavy solid impurities collect immediately above the bottom outlet. If the drain cock cannot be opened at once for any reason, these tars upon cooling set hard, and great difficulties are then experienced in removing the charge. However, this bottom is of ideal shape for separately drawing off water or lye without loss of benzene hydrocarbons.

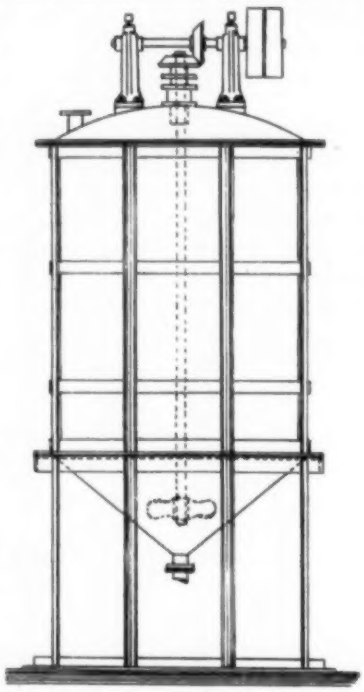


FIG. 1. SECTIONAL CAST-IRON WASHER

The bottom of the majority of washers is now tapered much less. The practice of having an acid washer from which the benzene is transferred into a second one for washing with water and lye has been abandoned nearly everywhere.

Propeller Agitator

The stirring arrangement is the most vital part of these washers. It is not enough simply to impart motion to the liquids. Owing to their comparatively great difference in density, they dissociate quickly and in order to maintain them in intimate contact, a very effective mixing is necessary. The acid has a tendency to settle on the bottom and the hydrocarbons tend to form a distinct upper layer. The propeller drives the acid upward into the hydrocarbon zone, from which it settles in a finely divided state. Experience has proved that the contents of the washer revolve with the propeller and the mixing is not sufficiently violent. Some improvement has been obtained by mounting in addition a horizontal paddlewheel just above the bottom section, geared by means of cog wheels to the vertical propeller shaft. The paddlewheel breaks up the boundary between the two liquids and acts as a brake to the rotating motion of the liquid in the washer. The disadvantage of such an arrangment is obvious in that the internal arrangement is not sufficiently accessible and cannot be oiled or greased.

Turbine Agitators

A similar washer with wrought-iron cylindrical shell and cast-iron lid and bottom section is shown in Fig. 2. A vertical pipe is rigidly fixed in the center of the lid extending into the washer guiding the agitator shaft, which reaches down as close to the bottom as possible.

The peculiar turbine wheel-like shape of the agitator insures better mixing and the semi-spherical shape of the bottom enables the stirring wheel to be placed very close to the draining outlet. This design, however, has not always proved advantageous. In cases where a large amount of solid impurities has settled out, these impurities cannot be withdrawn entirely without an accompanying amount of hydrocarbons, which, being fluid, have a tendency to force themselves through from above, before the impurities deposited on the sides have had time to reach the outlet. In all other respects the washer resembles the one shown in Fig. 1.

Different Methods of Agitating

It has generally been observed that the tendency of the two liquids in the washer to separate is greater than the effect of any stirring arrangement to mix them. To get a better washing effect with the new type of washers it is not enough simply to stir the liquids but one must be pumped through the other. This is accomplished in one of two ways. The hydrocarbons are pumped from the upper part of the washer and forced through the washing medium layer at the bottom, or the action is reversed and the washing medium is pumped from the bottom and forced into the upper zone through the hydrocarbons. In the former the benzene rises in finely divided drops to the top, in the latter the acid is sprayed through the benzene. In both cases an equally intense washing effect is obtained. As to the respective advantages and disadvantages of these washers, they appear to be about balanced. If the benzene is pumped from above through the acid, the pump rotor must be placed in the bottom and rotate and rest continually in the acid, the corrosive effects of which are soon felt, especially if a guide bearing for the shaft is provided at the bottom. If the bottom cock gets obstructed with congealed impurities, then the impeller wheel gets obstructed by these deposits, which impair the effect so much that it

FIG. 2. WROUGHT IRON WASHER WITH TURBINE STIRRER

must be cleaned by hand. The advantage of the above type rests with the fact that small charges of hydrocarbons can be treated, as the washer need not necessarily be full.

Free from the above-mentioned disadvantages is the second group of washers, in which the impeller is placed in the upper zone so that it comes in contact only with the acid while rotating. The quantity of hydrocarbons treated each time must always be sufficient to immerse the impeller completely. For plants which treat benzene hydrocarbons in great bulk and always work with full charges, this latter type of washer is to be recommended.

Upward Propelling Agitator

A simple type of washer in which the benzene is forced through the respective washing medium is shown in Fig. 3A. To the agitator shaft there is attached by spokes and brackets an inverted conic frustum, within which there is fastened an Archimedean screw. By revolving the frustum, the washing medium is drawn up by the screw and discharged at the top, where it passes down through the hydrocarbons to be circulated again.

Downward Propelling Agitator

In the type represented in Fig. 3B the action is reversed. Otherwise the arrangement is identical with that shown in Fig. 3A. The conical frustum is narrow at the top and wide at the bottom. The screw inside is arranged so that the hydrocarbons are forced downward through the cylinder and dispersed through the washing medium at the bottom, rising outside of the cylinder to the top, an action which is continuous.

Upward Propelling Agitator

In the washer shown in Fig. 3C the frustum around the Archimedean screw is stationary. It is held by a number of brackets on the washer bottom so that a passageway is formed underneath the cylinder edge. In the deepest part of the tapered bottom section of the washer, just over the draining outlet, a guide bearing

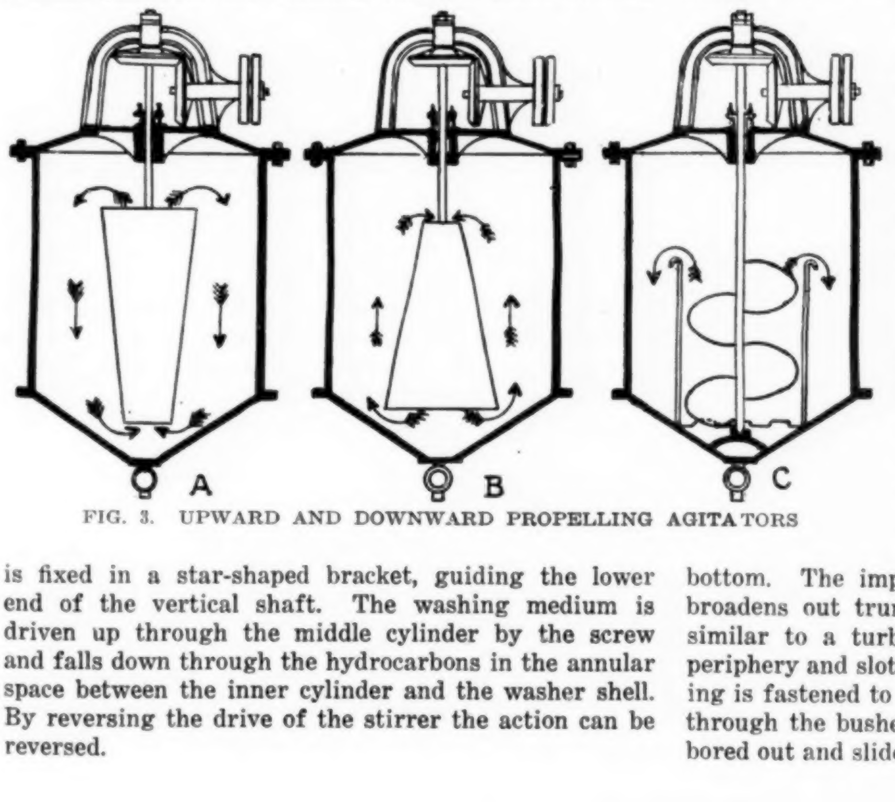


FIG. 3. UPWARD AND DOWNWARD PROPELLING AGITATORS

is fixed in a star-shaped bracket, guiding the lower end of the vertical shaft. The washing medium is driven up through the middle cylinder by the screw and falls down through the hydrocarbons in the annular space between the inner cylinder and the washer shell. By reversing the drive of the stirrer the action can be reversed.

The design shown in Fig. 3C has been improved to cover the whole diameter of the washer with the stirrer as shown in Fig. 4. The inner cylinder does not extend completely down to the tapered bottom of the washer, but rests on a number of brackets projecting horizontally inside. Under these brackets the star-like impeller, keyed to the suspended vertical shaft, is arranged; its diameter corresponds with that of the washer inside. The blades of the impeller are twisted propeller-like underneath the internal cylinder, and the ends extending outside of this cylinder are shaped like ordinary fan

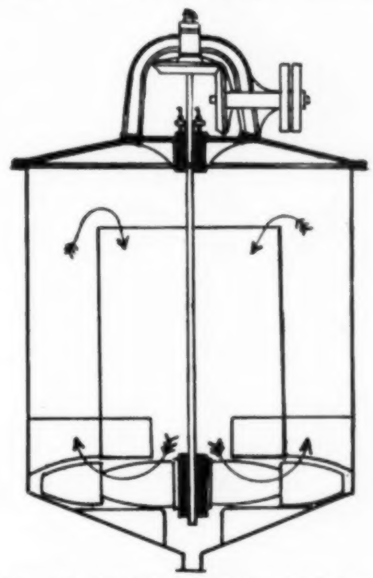


FIG. 4. COMBINED MIXING AND PROPELLING AGITATOR

blades. When revolving the shaft, the twisted inner portion of the impeller creates a suction inside the inner cylinder through which the hydrocarbons are forced down, and by leaving the cylinder at the bottom, passing through the washing medium, they are again effectively mixed by being agitated from the fan blades.

While in the types shown in Figs. 1 and 2 the contents of the washer are simply agitated, in Figs. 3A, B and C they are mixed by forcing the two zones through each other. In the latest designs of washers efforts have been made to combine both types to obtain the double effect. The first construction of this kind is shown in Fig. 4, where mechanical agitation is provided in addition to pumping.

Turbine Pump in Bottom

In the most modern types of washers a specially constructed turbine impeller has been adopted which not only pumps the liquid upward or downward but also throws it out with centrifugal force divided in very fine streams. Such a washer is shown in Fig. 5 which at the same time gives a good design for the bottom. The impeller has the form of a pipe which broadens out trumpet-like at the bottom and is built similar to a turbine pump with fine openings at its periphery and slots in the upper face. The impeller casting is fastened to the driving shaft by keys going right through the bushes and shaft. The impeller casting is bored out and slides over a pivot protruding through the

washer bottom and fastened tightly by a tapered bolt with nut at the end. The pivot serves as a guide; the shaft with impeller casting does not rest upon it, but is suspended freely and held by a ball bearing placed in a collar in the centre of the washer lid. The hydrocarbons are sucked down through the central tube and with centrifugal force are sprayed out of the openings on the periphery while the surplus is thrown out of the slots on the face, insuring a very effective mixing. The unfavorable effect of the acid upon the pivot is obvious and it need hardly be mentioned that the fine slots in the impeller get easily obstructed, if the impurities are allowed to congeal in the bottom.

Turbine Pump in Upper Part

The best type of washer for the treatment of full charges is represented in Fig. 6. Under the lid of the washer a number of right angle brackets are fastened, holding the vertical suction pipe, which broadens out at the top trumpet-like and reaches down close to the deepest point of the washer. It is fixed rigidly and does not revolve. Over the upper end of the pipe a turbine pump impeller of corresponding diameter to that of the trumpet end of the suction pipe rotates.

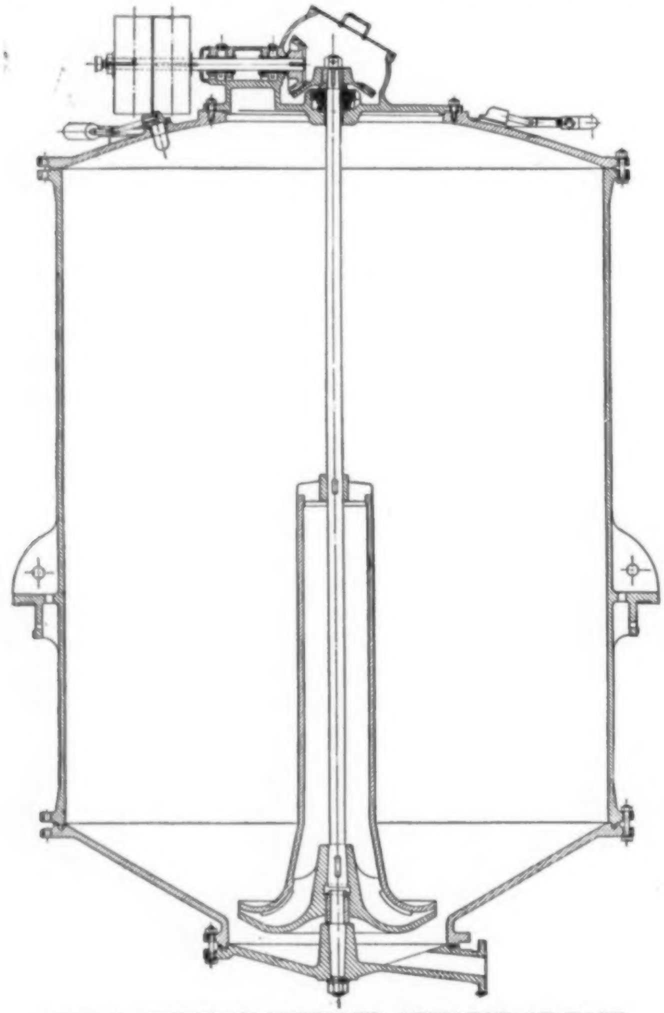


FIG. 5. TURBINE IMPELLER AGITATOR AT BASE

Under the top bearing in the lid of the washer a second bearing is arranged in a projecting bush about half way between washer lid and impeller, serving as a guide to the short impeller shaft. By revolving the impeller the washing medium is drawn up through the fixed pipe and thrown with centrifugal force in a spray through the hydrocarbons.

The advantages of this latter type are too obvious to call for much comment. Owing to the short impeller shaft, it requires less power and does not get out of order easily. No movable parts are immersed in acid and with proper construction of the lid, the internal parts can be made readily accessible without entering the washer. By comparing Figs. 5 and 6 it will be

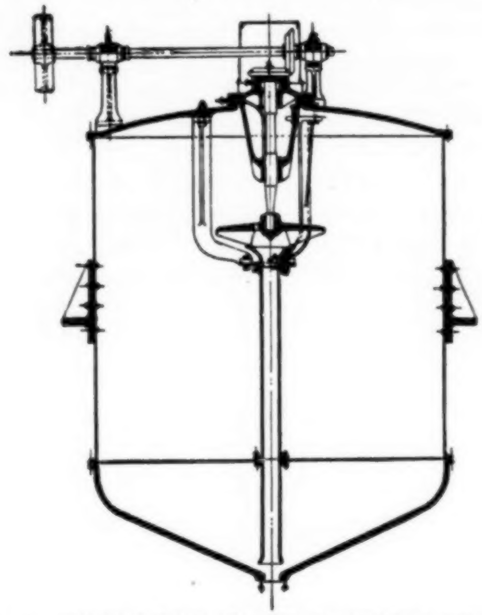


FIG. 6. TURBINE IMPELLER AGITATOR AT TOP

noted that the washer shown in Fig. 6 must be more than three-fourths full to immerse the impeller so as to obtain a washing effect. In Fig. 5 the washer need be only half full to immerse the top end of the impeller suction pipe.

Agitating by Compressed Air

Even at its best the placing of mechanical stirring or pumping devices inside the washer is disadvantageous. To make the interior of the washer accessible and safe for men to enter, it must be boiled out and ventilated a considerable time to insure the absence of poisonous vapors. Efforts have been made to construct washers in which all internal moving parts are obviated. The most obvious arrangement is the proper application of compressed air introduced into the washer in a great number of places. Though good mechanical washing can be obtained by this means, the direct application of compressed air for this purpose is not practicable, since the air gets carburetted and charged with benzene vapors while passing through the liquid. As a supplementary means, in cases of emergency, a compressed air connection to the bottom outlet pipe of the washer is, however, an advantage, should the outlet become obstructed or the internal stirring arrangement get out of order before washing is completed.

Washer Without Agitator

A good suggestion for a washer without internal moving parts is shown in Fig. 7, where a T-piece is provided under the washer outlet. To one end of this T-piece a centrifugal pump is connected by means of a cock or valve, the delivery pipe of which is conducted into the top of the washer and leads into a perforated coil. This coil is led round the periphery of the washer and has cross branches leading spoke-like to the center of the washer. The pump, which must be of

ample capacity, draws the washing medium from the bottom and forces it into the top coil, where by means of the perforations a fine distribution is obtained, while an intimate mixing is effected in the pump itself. To the suction pipe of the pump a water supply is connected for priming, so that the rest of the mixture contained in the pump and pipes can be driven out by water after the washing is completed and the valve in the suction pipe closed. Trials with this arrangement have been very promising as far as efficiency and convenience go; the only difficulty experienced rests with the glands of the pump, which wear out rapidly by coming in contact with acid and alkalis respectively.

Continuous Washers

In the endeavor to make the complete benzene plants continuous from the wash oil entering to the point where the finished products run into the store tanks,

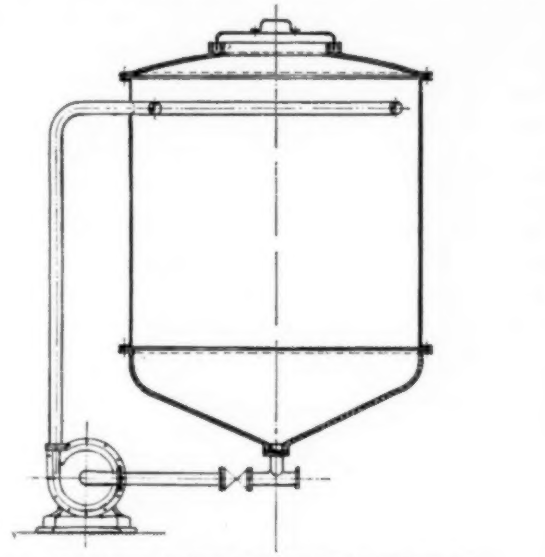


FIG. 7. WASHER WITH CENTRIFUGAL PUMP

continuously working washers had necessarily to be introduced. The designs so far tried have not given promising results. They have had to be discarded and at this stage it would serve no useful purpose to dwell upon their design.

Benzene Separator

Under the washer there is generally an open catch box arranged with central partition not reaching quite down to the bottom, and in such a manner that the flow entering from the washer outlet is spread out in a flat stream so as to make the appearance of hydrocarbons visible at once. The catch box must be fitted with easily operated valves or cocks so that its outlets can be closed suddenly to recover any hydrocarbons which may have entered and are retained by the central partition.

French North African Phosphate Deposits

A recent discussion among the French North African phosphate-mining interests has brought out the statement that the total annual production of phosphates in Tunisia, Algeria and Morocco is susceptible of an increase to 5,000,000 tons, of which amount Tunis should produce 2,000,000 tons. The present deficiency, reports Consul Cookingham at Tunis, of output is attributed largely to scarcity of available labor and lack of transportation facilities.

Effect of Ultra-Violet Rays on the Eye*

By Dr. C. R. Kindall†

Recently thirty men were viewing the demonstration of a new portable electric arc-welding outfit. A few hours later seventeen of the thirty men reported to the doctor for treatment. They were suffering from traumatic conjunctivitis. In two cases the pain was very severe and the symptoms were similar to those of iritis. Morphine had to be administered to afford relief from pain. Only two men of the thirty were not affected in some way from this exposure. These two men wore thick-lensed orange-colored glasses. Several of the men wore orange-colored glasses with thin lenses, but the latter were not heavy enough to afford protection against an exposure as long as took place. The distance of the eye from the arc also influences the possibility of injury. Conjunctivitis is an inflammation of the conjunctiva; the conjunctiva is the mucous membrane covering the inside of the eyelids and part of the eyeball. Traumatic conjunctivitis is caused by foreign bodies in the eye, exposure of the eyes to high winds, dust, smoke, intense light from electric arc lamps and from electric-welding apparatus. In the instance mentioned above, the inflammation was due to the ultra-violet rays. The ultra-violet rays lie beyond the violet rays in the spectrum and are invisible to the eye. In some cases the effect is so severe that, in addition to conjunctivitis, an inflammation of the skin similar to sunburn is produced.

The symptoms of conjunctivitis caused by intense light or by the ultra-violet rays are marked photophobia (abnormal intolerance to light), excessive secretion of tears, intense smarting of the lid, contraction of the pupil, sometimes swelling of the lid and small ulcers developing on the eyeball or cornea. Unless properly treated by a physician immediately, chronic inflammation of the conjunctiva, cornea, iris or retina, and possibly blindness, may result.

Under proper treatment most cases get well in a few days. All treatments should be under the direction of a physician. That usually advised is to place ice packs on the patient's eyes three or four times daily. The pack should be left on from fifteen minutes to an hour. The eyes should be irrigated with normal salt solution (a teaspoonful to a quart of sterile water) or a saturated solution of boric acid several times daily. If there is a discharge of pus, a few drops of a 25 per cent solution of argyrol or a 5 per cent solution of protargol should be placed in the eyes three to six times daily. The patient should be confined to a darkened room until his condition improves in order to avoid complications. These treatments will reduce the swelling, give the patient comfort, and prevent the development of chronic conjunctivitis. In severe cases it may be necessary to administer morphine to relieve the pain.

At every plant where electric arc-welding outfits are used there should be an adequate supply of glasses the lenses of which are made up of alternate layers of red and blue glass or orange glasses of sufficient thickness to protect the eyes from the effects of ultra-violet rays. There should also be on hand at the plant dispensary or hospital a supply of boric acid, sterilized water, ordinary table salt, argyrol and protargol for immediate use. As previously mentioned, all cases of traumatic conjunctivitis caused by exposure to bright light or ultra-violet rays should be treated under the direction of a physician.

*From Reports of Investigations, United States Bureau of Mines.
†Surgeon, Bureau of Mines.

The Fundamentals of the Electrolytic Diaphragm Cell*—II

Effect of Washing Diaphragms on Voltage and Current and Decomposition Efficiencies—Removal of Alkaline Earths From Brine—Use of Purified and Crude Brine Liquors†

BY HUGH KELSEA MOORE

THERE has been a great deal said and written about the merits of this cell and that cell, but little has been said about the use and abuse of cells in general or cells of the same type.

It thus happens that the exponent of one make of cell can take data from a plant using his cell running under favorable conditions and compare this with data taken from a plant using his competitor's cell running under unfavorable conditions. Neither of these results gives the buyer the exact truth, though it may help to sell the product inasmuch as the purchaser may be fooled into accepting these statements as representative of what may be expected of different makes of cells, when in most cases differences in the results can be more than accounted for by methods of operation.

Suppose an exponent of one cell goes to a would-be purchaser of some cell and gives A the following line of talk: "Come and visit our plant at Y and look at our records. You will find these cells running in a voltage of 3.4 to 3.6, amperes 1,200, current efficiency 95 to 97 per cent, decomposition efficiency 52 per cent, average power efficiency of 63 per cent, age of diaphragm 280 days, life of carbons 16 to 18 months, etc.

"If you will go to town W you will find an installation of our competitor's cells. You will find this plant running with cells having a voltage ranging from 3.3 to 4.7, or at an average of 4 volts. The current efficiency varies from 97 per cent on some cells to 66 per cent on others. The current varies from 1,200 to 1,800 amp. with a power efficiency varying from 67 per cent to 29 per cent, averaging perhaps 48 per cent. The age of the diaphragm in this plant is eighty-four days and the life of the carbons four months."

With two statements before him like this he would undoubtedly take the cell represented by Plant Y, especially if he knew nothing about electrolytic cells and their operation. And yet he may be very far from the truth. Do you know that the method of operation in two installations of the same cell can and does make greater differences than those stated above? One plant may be able to run its installation with a non-varying current density at the cathode while another plant finds that owing to conditions of varying load on other parts of the line it cannot furnish a constant current. One operator may not see the necessity of purifying his brine, while another may. These conditions alone will make startling differences in the results obtained.

EFFECT OF WASHING ON VOLTAGE

To show this Fig. 7 is submitted with curves *A*, *B* and *C*. *A* is a cell run constantly at 1,200 amp. current, with purified brine and with the diaphragm washed with water for a period of twenty-four hours once every thirty days. *B* is a cell running on purified brine, with amperage varying from 1,200 to 1,900. The varying voltages in this and *C* have been adjusted by means of a correction chart to 1,200 amp. In this case washings were made at the end of sixty-one days, at the end of ninety days and at the end of 113 days. Curve *C* is a case where a cell running on impure brine has been washed at the end of sixty-one days, ninety days and 115 days. Curves *A* and *B* are on cells of purified brine.

In curve *C* unpurified brine was used. In order that

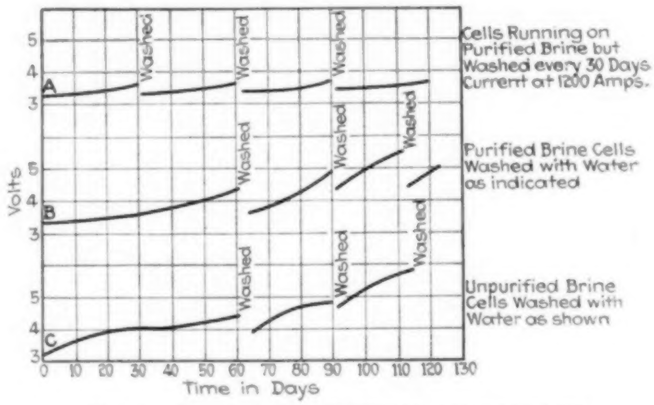


FIG. 7. EFFECT OF WASHING ON VOLTAGE

there may be no misunderstanding in relation to the salt and brine, the following compositions are given and in considering curves 7*A*, *B* and *C*, you will consider that the brine does not vary from what is given here.

For example, let us take a salt which analyzes as follows:

	Per Cent		Per Cent
Insoluble matter	0.40	$CaSO_4$	0.70
$CaCl_2$	0.36	NaCl	98.54
$MgCl_2$	Trace		100.00

With brine made up 2½ lb. to the gallon we get from the above:

	Grams per Liter		Grams per Liter
Insoluble matter	1.20	$CaSO_4$	2.10
$CaCl_2$	1.08	NaCl	285.62
$MgCl_2$	Trace		
Total grams other than water per liter			290.00

After adding soda ash to about 1 per cent excess of the requirements, filtering and neutralizing with HCl, we get a solution of the following composition:

	Grams per Liter		Grams per Liter
Insoluble matter	None	$CaSO_4$	Heavy trac[e]
$CaCl_2$	None	Na_2SO_4	2.20
$MgCl_2$	Trace	NaCl	286.76

Now let us see the results of feeding the above-mentioned impure brine to a cell and compare these with the results obtained from the purified brine.

It will be observed that in *C* the voltage rises to 3.6 at the end of ten days, while in *A* and *B* the voltag[e]

*Read before the American Institute of Chemical Engineers, Montreal, June 28, 1920.
†For Part I see CHEM. & MET. ENG., vol. 23, No. 21, Nov. 24, 1920, p. 1011.

does not rise to 3.6 until thirty days. If now the cells running on purified brine are washed at the end of thirty days for twenty-four hours, with water, it will be found upon starting up the voltage will have dropped to somewhere between 3.3 and 3.4. In the case before you the voltage upon starting up was 3.3. If the cell is again washed at the end of another thirty days or less we will have a similar drop, though slightly less.

Variation of Voltage With Use

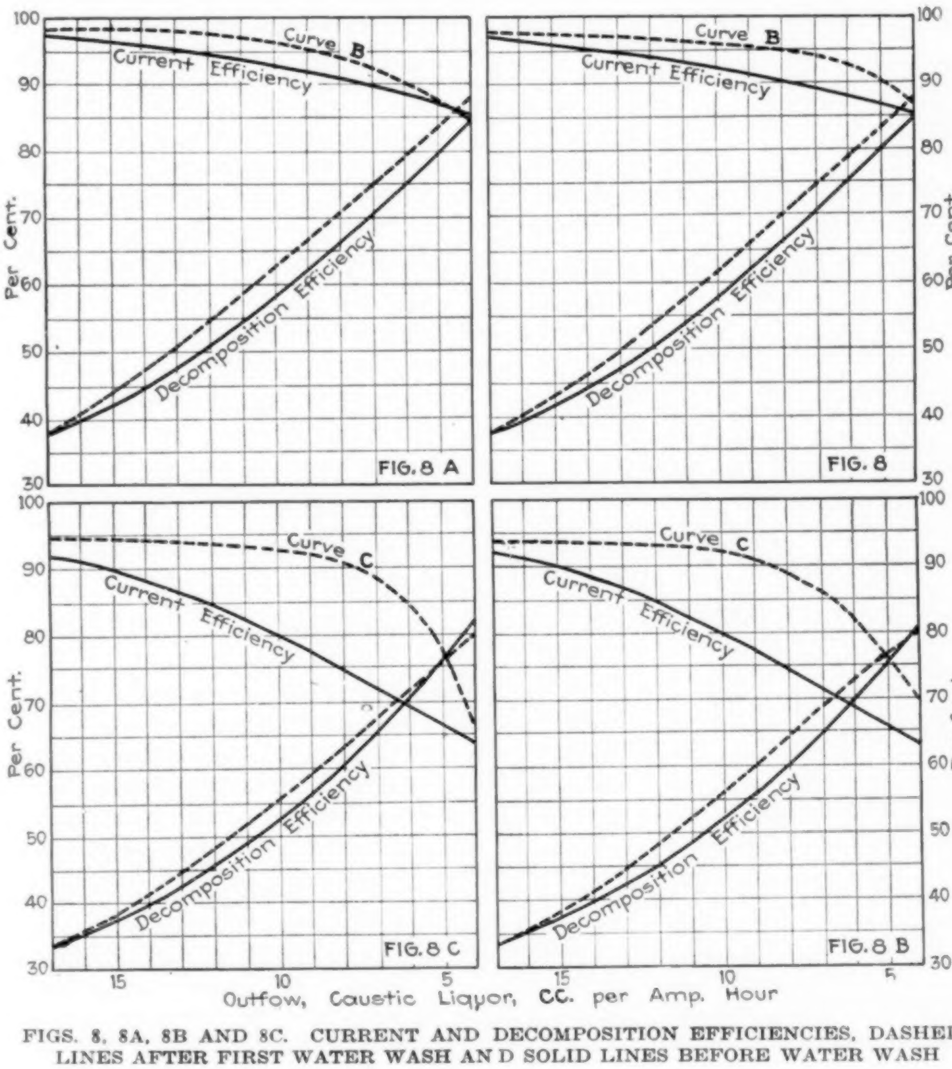
Curves *B* and *C* may be misleading unless certain explanations are made. It will be noticed that after thirty days the voltage goes up at a faster rate than at the beginning of this period. This is due to some extent to the accumulation of impurities during the thirty-day period, but in the main this is due to the great increase in impurities in the diaphragm due to excessive amperage. During this time the amperage was uniformly higher than 1,200 amp., going at times to nearly 2,000 amp. Consequently more brine had to be fed to the cells in a given time, with the consequent increase of impurities in the diaphragm. While the voltage has been corrected for excessive amperage, it has not been corrected for these accumulated impurities. Compare curve *C*, which represents a cell running under the same conditions as that in curve *B* with the exception that the brine is not purified. It will be noticed that the curve rises very rapidly at the start but flattens out as the age increases. This is due to the fact that with more impurities in the brine the plugging of the diaphragm was greater and the liquor in the cell rising to its limit automatically checked the inflow of liquor coming in through the float valve. Now cells represented by curve *C* started in at an initial flow of 21.00 c.c. per amp.-hr. (1,200 amp., 26.5 sq.ft. of diaphragm), and at the end of ten days the flow in spite of the increasing static head had been reduced to 7 c.c. per amp.-hr., or only one-third as much as at first. A flow of about 9 c.c. per amp.-hr. is good practice. The cell represented by *C* has had its diaphragm plugged so rapidly that the diaphragm should have been washed at the end of ten days and this washing would not have been entirely satisfactory.

Now cells represented by curves *A* and *B* start in with an initial rate of flow of 30 c.c. per amp.-hr. and at the end of ten days, without any raise of static head, drop to a rate of 15 c.c. per amp.-hr. From the above you would naturally expect a flat voltage curve on curve *B*, as there are few impurities and the flow is so rapid that one would expect that they would lodge only to a small extent in the diaphragm. You would also expect a rapidly rising voltage curve on curve *C*, as we have here all the impurities and the flow is so reduced that they must lodge in the diaphragm.

Diaphragms Improve With Use After Washing

I wish to bring out another fact oftentimes not appreciated, and that is that washing the diaphragm not only saves the cost of a new diaphragm together with the labor needed to change the same but the washed diaphragm is actually a better diaphragm than a new diaphragm. In order to show this I submit Fig 8, corresponding with curve *B* of Fig. 7, showing the effect the washing has on the current efficiency. The ordinates are current efficiencies and decomposition efficiencies and the abscissæ are c.c. of flow per amp.-hr. The heavy black line shows efficiencies in terms of the rate of flow in c.c. per amp.-hr. on a diaphragm which has not been washed out. The dotted line shows the change in current efficiency on same diaphragm after washing with water. It will be noticed that the current efficiency and decomposition efficiency are raised for the same rate of flow in both cases.

If you refer to Fig. 8A, representing curve *B*, Fig. 7, you will see the effect of the second washing. The heavy black line represents the same facts as in Fig. 8. Similarly Fig. 8B and Fig. 8C, corresponding to curve *C*, show that both the current efficiency and decomposition efficiency are raised for the same rate of flow for both efficiencies by washing with water. I have



FIGS. 8, 8A, 8B AND 8C. CURRENT AND DECOMPOSITION EFFICIENCIES, DASHED LINES AFTER FIRST WATER WASH AN D SOLID LINES BEFORE WATER WASH

many such charts of cells run under many different conditions and find that practically all show this characteristic. In order that the information contained in the above may be available to users of cells having varying diaphragm areas I will state that these areas of diaphragm in the above cases were 26.5 sq.ft. each. I should like to give more time to this subject, but must drop it at this point in order to take up other subjects.

TABLE VII

Electrolytic Plant of Dill & Collins, July 19, 1919. Current amperes, 1,200

Cell No.	Days Run	Voltage	Percent Current Eff.	Liters per Hr.	Cell No.	Days Run	Voltage	Percent Current Eff.	Liters per Hr.
1	151	3.50	102.2	17.6	32	169	3.70	a	a
2	195	3.50	96.3	15.4	33	157	3.60	a	a
3	125	3.50	95.5	15.6	34	172	3.65	a	a
4	201	3.50	91.2	13.0	35	170	3.55	a	a
5	171	3.55	100.6	18.6	36	199	3.50	91.4	18.6
6	168	3.50	102.6	17.0	37	163	3.50	91.4	18.6
7	145	3.60	93.0	14.4	38	120	3.50	a	a
8	201	3.50	94.8	13.6	39	174	3.50	89.4	18.6
9	146	3.50	101.3	18.0	40	146	3.60	90.0	16.4
10	104	3.66	104.6	15.0	41	184	3.60	94.1	14.8
11	201	3.60	94.4	17.6	42	168	3.55	95.5	17.8
12	168	3.50	96.2	17.8	43	168	3.60	99.0	16.1
13	49	3.50	95.2	14.6	44	168	3.50	94.2	17.0
14	117	3.60	98.8	17.0	45	140	3.50	92.3	17.2
15	191	3.55	96.8	17.2	46	196	3.60	86.7	15.0
16	192	3.65	91.5	16.0	47	143	3.60	93.6	17.0
17	156	3.50	106.6	15.6	48	219	3.55	100.4	18.8
18	146	3.60	94.1	17.4	49	196	3.60	116.8	19.8
19	168	3.50	98.3	16.0	50	191	3.50	95.2	17.6
20	109	3.55	97.6	14.8	51	177	3.55	94.8	14.6
21	141	3.50	91.5	15.4	52	173	3.65	96.7	15.4
22	192	3.50	96.4	17.4	53	191	3.65	90.5	16.2
23	119	3.60	95.9	15.6	54	174	3.55	93.8	17.8
24	154	3.60	95.2	14.8	55	227	3.50	94.8	15.6
25	196	3.60	92.0	16.6	56	248	3.55	92.0	12.4
26	199	3.60	95.2	15.2	57	97	3.55	90.7	17.0
27	173	3.60	97.8	19.2	58	186	a	a	a
28	166	3.55	a	a	59	94	3.60	93.4	16.2
29	170	3.45	a	a	60	191	3.50	96.1	12.8
30	173	3.55	a	a	61	177	3.55	87.8	14.4
31	171	3.65	a	a	62	120	3.60	93.4	16.2

a Cells had been shut down to wash and had just started up, so efficiencies had not been taken.

Average run in days, 165. Average voltage, 3.55. Average current eff., 95.6. Average liters per hr., 16.3. Current held at 1,212 amp. Decomposition efficiency held as close to 50 per cent as possible.

I cannot, however, let the matter drop without giving at least one illustration as to how curve *A* may be carried out in practice. I submit Table VII, taken from Dill & Collins' plant, July 19, 1919.

Average Data Necessary

It will be noticed that no cell had been changed for forty-nine days, while the oldest cell was 248 days. It will be noticed that certain cells show an efficiency of over 100 per cent. These are errors which may occur in various ways. The low efficiencies may also be errors. The average efficiency is undoubtedly correct. I shall discuss later some of the factors contributing to calculations of current efficiency in an electrolytic cell, but right here I wish to mention a factor which will show why even though the high and low figures may be wrong, the average of the total may be correct. In testing for the current efficiency of a cell the amount of caustic liquor which runs off in a given period of time is tested for caustic soda and the current efficiency is calculated from the above and the number of amperes passing through at the time. Now if due to evaporation there is an accumulation of salt in the outlet pipe, we would have a slight damming up of caustic in the cathode chamber and we would be getting a less amount of caustic liquor than actually flowed through the diaphragm and consequently the current efficiency for such cells would show lower than the actual. If, on the other hand, the salt which had partially obstructed the flow of caustic liquor should dissolve out while the test is being taken, the flow from the cell would be greater than the flow through the diaphragm and consequently the current efficiencies for such cells would show higher than they actually are. The caustic solution is always unsaturated as regards both caustic and salt so that the obstructions are bound to dissolve out. Of course the longer the test the less will be the effect of such disturbances. Of course if long tests are taken the efficiencies of all the cells cannot be taken at one time. So the short cell test has a certain advantage, even though there may in a few cases be a small inaccuracy. On a large number of cells it has been found that the increasing flow in some cells compensates for the decreasing flow in other cells, so that the average efficiency for all the cells checks with the efficiency of the plant. Consequently, with this explanation it is better to submit all the figures as taken than to take the risk of rejecting the high and low figures.

The decomposition efficiencies are not tabulated, but each cell is run as close to 50 per cent decomposition efficiency as factory operation will allow. This table is not a selected table, but one which was taken on the date when two of my representatives happened to visit the plant. This is especially instructive in showing how systematic washing of cells combined with efficient management can keep cells from deteriorating. Dill & Collins' plant will show results comparable to the above any day in the year. I have been informed that the carbons in this plant last sixteen to eighteen months.

Compare the life of the carbons in a plant run as above with the life of carbons in a cell using impure brine as in curve *C* in Fig. 7. In this case the carbons other than the spacing blocks were used up in less than 120 days. In cells represented by curve *B* the carbons were whole and good for a much longer time.

From the above it will be seen that proper care of an electrolytic cell is as important a factor as the proper care of an engine. Perhaps I can bring this more forcibly to your attention if I give some comparative figures of costs.

TABLE VIII. COST PER TON SALT, DECOMPOSED

	Curve *A*	Curve *B*	Curve *C*
Carbons	$1.03	$2.11	$4.34
Asbestos	0.38	0.58	0.72
Power	9.46	11.85	15.61
Total	$10.87	$14.54	$20.67

Assuming carbons at 22c. per lb., asbestos paper at $1 per lb., 1 hp.-yr. (24 hr. a day) $40, we find that the costs for these three items alone come to the figures shown in Table VIII.

(Part III will appear in a subsequent issue.)

Lizard-Skin Industry in India

The lizard-skin industry forms a new branch in the hides and skins trade in India, states Consul Foss, of Calcutta. There are being manufactured from these skins, in various shades, ladies' and children's shoes, purses and handbags and other articles which are now being made from calfskin and kid, and the wear has proved to be as good as articles made from glacé kid. The skins, averaging 2 sq.ft., are collected from the jungles of Orissa and manufactured in the tanneries at Cuttack. Prices for the prepared skins are 32c. each and the shoes manufactured from them are being made to order at $4 per pair.

Temperature Conversion Tables

BY ALBERT SAUVEUR

—459.4 to 0

C.		F.
—273	**—459.4**	
—268	**—450**	
—262	**—440**	
—257	**—430**	
—251	**—420**	
—246	**—410**	
—240	**—400**	
—234	**—390**	
—229	**—380**	
—223	**—370**	
—218	**—360**	
—212	**—350**	
—207	**—340**	
—201	**—330**	
—196	**—320**	
—190	**—310**	
—184	**—300**	
—179	**—290**	
—173	**—280**	
—169	**—273**	—459.4
—168	**—270**	—454
—162	**—260**	—436
—157	**—250**	—418
—151	**—240**	—400
—146	**—230**	—382
—140	**—220**	—364
—134	**—210**	—346
—129	**—200**	—328
—123	**—190**	—310
—118	**—180**	—292
—112	**—170**	—274
—107	**—160**	—256
—101	**—150**	—238
— 95.6	**—140**	—220
— 90.0	**—130**	—202
— 84.4	**—120**	—184
— 78.9	**—110**	—166
— 73.3	**—100**	—148
— 67.8	**— 90**	—130
— 62.2	**— 80**	—112
— 56.7	**— 70**	— 94
— 51.1	**— 60**	— 76
— 45.6	**— 50**	— 58
— 40.0	**— 40**	— 40
— 34.4	**— 30**	— 22
— 28.9	**— 20**	— 4
— 23.3	**— 10**	14
— 17.8	**0**	32

0 to 100

C.		F.	C.		F.
—17.8	**0**	32	10.0	**50**	122.0
—17.2	**1**	33.8	10.6	**51**	123.8
—16.7	**2**	35.6	11.1	**52**	125.6
—16.1	**3**	37.4	11.7	**53**	127.4
—15.6	**4**	39.2	12.2	**54**	129.2
—15.0	**5**	41.0	12.8	**55**	131.0
—14.4	**6**	42.8	13.3	**56**	132.8
—13.9	**7**	44.6	13.9	**57**	134.6
—13.3	**8**	46.4	14.4	**58**	136.4
—12.8	**9**	48.2	15.0	**59**	138.2
—12.2	**10**	50.0	15.6	**60**	140.0
—11.7	**11**	51.8	16.1	**61**	141.8
—11.1	**12**	53.6	16.7	**62**	143.6
—10.6	**13**	55.4	17.2	**63**	145.4
—10.0	**14**	57.2	17.8	**64**	147.2
— 9.44	**15**	59.0	18.3	**65**	149.0
— 8.89	**16**	61.8	18.9	**66**	150.8
— 8.33	**17**	63.6	19.4	**67**	152.6
— 7.78	**18**	65.4	20.0	**68**	154.4
— 7.22	**19**	67.2	20.6	**69**	156.2
— 6.67	**20**	68.0	21.1	**70**	158.0
— 6.11	**21**	69.8	21.7	**71**	159.8
— 5.56	**22**	71.6	22.2	**72**	161.6
— 5.00	**23**	73.4	22.8	**73**	163.4
— 4.44	**24**	75.2	23.3	**74**	165.2
— 3.89	**25**	77.0	23.9	**75**	167.0
— 3.33	**26**	78.8	24.4	**76**	168.8
— 2.78	**27**	80.6	25.0	**77**	170.6
— 2.22	**28**	82.4	25.6	**78**	172.4
— 1.67	**29**	84.2	26.1	**79**	174.2
— 1.11	**30**	86.0	26.7	**80**	176.0
— 0.56	**31**	87.8	27.2	**81**	177.8
0	**32**	89.6	27.8	**82**	179.6
0.56	**33**	91.4	28.3	**83**	181.4
1.11	**34**	93.2	28.9	**84**	183.2
1.67	**35**	95.0	29.4	**85**	185.0
2.22	**36**	96.8	30.0	**86**	186.8
2.78	**37**	98.6	30.6	**87**	188.6
3.33	**38**	100.4	31.1	**88**	190.4
3.89	**39**	102.2	31.7	**89**	192.2
4.44	**40**	104.0	32.2	**90**	194.0
5.00	**41**	105.8	32.8	**91**	195.8
5.56	**42**	107.6	33.3	**92**	197.6
6.11	**43**	109.4	33.9	**93**	199.4
6.67	**44**	111.2	34.4	**94**	201.2
7.22	**45**	113.0	35.0	**95**	203.0
7.78	**46**	114.8	35.6	**96**	204.8
8.33	**47**	116.6	36.1	**97**	206.6
8.89	**48**	118.4	36.7	**98**	208.4
9.44	**49**	120.2	37.2	**99**	210.2
			37.8	**100**	212.0

100 to 1000

C.		F.	C.		F.
38	**100**	212	260	**500**	932
43	**110**	230	266	**510**	950
49	**120**	248	271	**520**	968
54	**130**	266	277	**530**	986
60	**140**	284	282	**540**	1004
66	**150**	302	288	**550**	1022
71	**160**	320	293	**560**	1040
77	**170**	338	299	**570**	1058
82	**180**	356	304	**580**	1076
88	**190**	374	310	**590**	1094
93	**200**	392	316	**600**	1112
99	**210**	410	321	**610**	1130
100	**212**	413	327	**620**	1148
104	**220**	428	332	**630**	1166
110	**230**	446	338	**640**	1184
116	**240**	464	343	**650**	1202
121	**250**	482	349	**660**	1220
127	**260**	500	354	**670**	1238
132	**270**	518	360	**680**	1256
138	**280**	536	366	**690**	1274
143	**290**	554	371	**700**	1292
149	**300**	572	377	**710**	1310
154	**310**	590	382	**720**	1328
160	**320**	608	388	**730**	1346
166	**330**	626	393	**740**	1364
171	**340**	644	399	**750**	1382
177	**350**	662	404	**760**	1400
182	**360**	680	410	**770**	1418
188	**370**	698	416	**780**	1436
193	**380**	716	421	**790**	1454
199	**390**	734	427	**800**	1472
204	**400**	752	432	**810**	1490
210	**410**	770	438	**820**	1508
216	**420**	788	443	**830**	1526
221	**430**	806	449	**840**	1544
227	**440**	824	454	**850**	1562
232	**450**	842	460	**860**	1580
238	**460**	860	466	**870**	1598
243	**470**	878	471	**880**	1616
249	**480**	896	477	**890**	1634
254	**490**	914	482	**900**	1652
			488	**910**	1670
			493	**920**	1688
			499	**930**	1706
			504	**940**	1724
			510	**950**	1742
			516	**960**	1760
			521	**970**	1778
			527	**980**	1796
			532	**990**	1814
			538	**1000**	1832

1000 to 2000

C.		F.	C.		F.
538	**1000**	1832	816	**1500**	2732
543	**1010**	1850	821	**1510**	2750
549	**1020**	1868	827	**1520**	2768
554	**1030**	1886	832	**1530**	2786
560	**1040**	1904	838	**1540**	2804
566	**1050**	1922	843	**1550**	2822
571	**1060**	1940	849	**1560**	2840
577	**1070**	1958	854	**1570**	2858
582	**1080**	1976	860	**1580**	2876
588	**1090**	1994	866	**1590**	2894
593	**1100**	2012	871	**1600**	2912
599	**1110**	2030	877	**1610**	2930
604	**1120**	2048	882	**1620**	2948
610	**1130**	2066	888	**1630**	2966
616	**1140**	2084	893	**1640**	2984
621	**1150**	2102	899	**1650**	3002
627	**1160**	2120	904	**1660**	3020
632	**1170**	2138	910	**1670**	3038
638	**1180**	2156	916	**1680**	3056
643	**1190**	2174	921	**1690**	3074
649	**1200**	2192	927	**1700**	3092
654	**1210**	2210	932	**1710**	3110
660	**1220**	2228	938	**1720**	3128
666	**1230**	2246	943	**1730**	3146
671	**1240**	2264	949	**1740**	3164
677	**1250**	2282	954	**1750**	3182
682	**1260**	2300	960	**1760**	3200
688	**1270**	2318	966	**1770**	3218
693	**1280**	2336	971	**1780**	3236
699	**1290**	2354	977	**1790**	3254
704	**1300**	2372	982	**1800**	3272
710	**1310**	2390	988	**1810**	3290
716	**1320**	2408	993	**1820**	3308
721	**1330**	2426	999	**1830**	3326
727	**1340**	2444	1004	**1840**	3344
732	**1350**	2462	1010	**1850**	3362
738	**1360**	2480	1016	**1860**	3380
743	**1370**	2498	1021	**1870**	3398
749	**1380**	2516	1027	**1880**	3416
754	**1390**	2534	1032	**1890**	3434
760	**1400**	2552	1038	**1900**	3452
766	**1410**	2570	1043	**1910**	3470
771	**1420**	2588	1049	**1920**	3488
777	**1430**	2606	1054	**1930**	3506
782	**1440**	2624	1060	**1940**	3524
788	**1450**	2642	1066	**1950**	3542
793	**1460**	2660	1071	**1960**	3560
799	**1470**	2678	1077	**1970**	3578
804	**1480**	2696	1082	**1980**	3596
810	**1490**	2714	1088	**1990**	3614
			1093	**2000**	3632

2000 to 3000

C.		F.	C.		F.
1093	**2000**	3632	1371	**2500**	4532
1099	**2010**	3650	1377	**2510**	4550
1104	**2020**	3668	1382	**2520**	4568
1110	**2030**	3686	1388	**2530**	4586
1116	**2040**	3704	1393	**2540**	4604
1121	**2050**	3722	1399	**2550**	4622
1127	**2060**	3740	1404	**2560**	4640
1132	**2070**	3758	1410	**2570**	4658
1138	**2080**	3776	1416	**2580**	4676
1143	**2090**	3794	1421	**2590**	4694
1149	**2100**	3812	1427	**2600**	4712
1154	**2110**	3830	1432	**2610**	4730
1160	**2120**	3848	1438	**2620**	4748
1166	**2130**	3866	1443	**2630**	4766
1171	**2140**	3884	1449	**2640**	4784
1177	**2150**	3902	1454	**2650**	4802
1182	**2160**	3920	1460	**2660**	4820
1188	**2170**	3938	1466	**2670**	4838
1193	**2180**	3956	1471	**2680**	4856
1199	**2190**	3974	1477	**2690**	4874
1204	**2200**	3992	1482	**2700**	4892
1210	**2210**	4010	1488	**2710**	4910
1216	**2220**	4028	1493	**2720**	4928
1221	**2230**	4046	1499	**2730**	4946
1227	**2240**	4064	1504	**2740**	4964
1232	**2250**	4082	1510	**2750**	4982
1238	**2260**	4100	1516	**2760**	5000
1243	**2270**	4118	1521	**2770**	5018
1249	**2280**	4136	1527	**2780**	5036
1254	**2290**	4154	1532	**2790**	5054
1260	**2300**	4172	1538	**2800**	5072
1266	**2310**	4190	1543	**2810**	5090
1271	**2320**	4208	1549	**2820**	5108
1277	**2330**	4226	1554	**2830**	5126
1282	**2340**	4244	1560	**2840**	5144
1288	**2350**	4262	1566	**2850**	5162
1293	**2360**	4280	1571	**2860**	5180
1299	**2370**	4298	1577	**2870**	5198
1304	**2380**	4316	1582	**2880**	5216
1310	**2390**	4334	1588	**2890**	5234
1316	**2400**	4352	1593	**2900**	5252
1321	**2410**	4370	1599	**2910**	5270
1327	**2420**	4388	1604	**2920**	5288
1332	**2430**	4406	1610	**2930**	5306
1338	**2440**	4424	1616	**2940**	5324
1343	**2450**	4442	1621	**2950**	5342
1349	**2460**	4460	1627	**2960**	5360
1354	**2470**	4478	1632	**2970**	5378
1360	**2480**	4496	1638	**2980**	5396
1366	**2490**	4514	1643	**2990**	5414
			1649	**3000**	5432

NOTE:—The numbers in bold face type refer to the temperature either in degrees Centigrade or Fahrenheit which it is desired to convert into the other scale. If converting from Fahrenheit degrees to Centigrade degrees the equivalent temperature will be found in the left column, while if converting from degrees Centigrade to degrees Fahrenheit, the answer will be found in the column on the right. These tables are a revision of those by Sauveur & Boylston, metallurgical engineers, Cambridge, Mass. Copyright, 1920.

INTERPOLATION FACTORS

C.		F.	C.		F.
0.56	**1**	1.8	3.33	**6**	10.8
1.11	**2**	3.6	3.89	**7**	12.6
1.67	**3**	5.4	4.44	**8**	14.4
2.22	**4**	7.2	5.00	**9**	16.2
2.78	**5**	9.0	5.56	**10**	18.0

Legal Notes

By Wellington Gustin

Option in a Chemical Contract Must Be Exercised Within a Reasonable Time

Finding that the Chatham Manufacturing Co., seller, did not exercise within a reasonable time an option to increase the total amount of acid sold to the Avery Chemical Co., the Supreme Judicial Court of Massachusetts at Suffolk has ruled denying the seller the right to increase the order from 500 to 2,500 bbl. and claim damages for failure of the chemical company to accept the larger quantity.

Under a written contract the chemical company agreed to buy 500 bbl. of pyroligenous acid at 5c. per gal., the amount to be increased at the seller's option to 2,500 bbl., "shipments to begin as soon as possible." This acid was a byproduct from the distillation of soft pine lumber and formerly was a waste product. At the time of making the contract, in January, 1918, it was in demand for the making of iron liquor used in the dyeing and coloring of khaki cloth for the Government. The demand for this ceased later in 1918, and from that time the acid had no market value. The seller's weekly output was about 75 gal., at a cost of ½c. a gal.

None of the acid was shipped to the buyer until August, during which month 125 bbl. was received and paid for. After several letters were passed between the parties, the buyer notified seller to ship no more of the acid, conceded its liability for failure to accept 375 bbl. and damages at 4½c. a gal., amounting to $863.34. The seller attempted to recover damages for the failure to take 2,000 bbl., which, under the option, it claimed the right to deliver. The principal question presented to the court was whether the option, if it should be decided it was exercised by the seller, was exercised within a reasonable time.

No time limit was set for carrying the option into effect. The trial court said that in order to bind the buyer it was essential that the option should have been exercised within a reasonable time, and so the Supreme Court ruled.

What Is a Reasonable Time?

Now where all the facts are shown it is a question of law what was a reasonable time for exercise of the seller's option to increase the quantity deliverable from 500 to 2,500 bbl. of acid. The facts show that the contract was made in January, 1919, and various communications were exchanged concerning delays on the part of the buyer, until the seller wrote the buyer Nov. 23, 1918, saying that it expected the buyer to take 2,500 bbl. of pyro acid.

The court thought the delay in exercising this option was not a reasonable length of time, considering the other circumstances that the contract involved called for a kind of acid useful solely for the dyeing of soldiers' clothing. When that demand ceased the acid contracted for was no longer salable, facts which the seller well knew. The court found that with a production of 75 bbl. weekly the 500 bbl. contracted for would be ready for delivery by April 1. No notice was then given that the seller intended to exercise the option, and there was no such notice until several months later. The court said the option could not remain open indefinitely and the seller knew the war crisis caused execution of the contract. A letter in August was held to extend the time of deliveries and likewise the time for exercising the option. The court here held such extension must be for a reasonable time.

Finding that the notice by the seller that it exercised the option to increase the quantity of acid to be delivered was given after signing of the armistice and cessation of hostilities, when seller knew there was no further demand for its product, the court was convinced that the option was not exercised within a reasonable time. Therefore the seller could not recover on its claim.

Injury to Employee From Fumes in Factory

The Court of Appeals of Georgia has refused to dismiss the amended petition of Ryan, administrator of the estate of Arthur Durant, in his action for personal injuries against the American Agricultural Chemical Co., brought in the Superior Court for Chatham County, Ga.

The amended petition alleged that the chemical company operated a plant for the manufacture of fertilizer and maintained a nitrate tank 8 ft. square, 4 ft. deep and standing 3 ft. above the floor, and that there was another receptacle a few feet from the tank, known as a boot, 18 in. in diameter, 2 ft. deep, the top being flush with the floor, while a lead pipe ran from the bottom of the tank to the boot; that in flushing out the tank an employee was required to hold the nozzle of a hose over the top of a tank, which washed the accumulations in the tank through the pipe into the boot; that vapors and gases arose from the accumulations, which were of a poisonous nature, so that the employee engaged in washing out the tank was required to keep his head to the side of the tank, so as to not inhale the fumes; that Durant, while holding the hose to flush out the tank on orders from his foreman, was subjected to fumes not easily discernible by the sense of smell and his clothing was saturated therewith; that the foreman refused to allow a co-employee to place a sack over the boot to prevent such fumes escaping; that Durant was rendered partly unconscious by the fumes, and while in such condition he wandered to a lower floor of the building and sat down near a mill acid tank, from which dangerous position he was rescued and taken to a hospital in a police ambulance. The petition then alleges that his throat and lungs were seriously affected, to his damage in the sum of $20,000.

The action was originally brought by Arthur Durant, the employee, but upon his death an administrator was appointed. The questions presented to the court were those of diligence and negligence on the part of the employer in preventing the injury and rescuing the employee, coupled with contributory negligence of the employee. These questions, the court said, were matters of fact peculiarly for the jury to determine, and a court will decline to solve them except in plain and indisputable cases.

Citing a controlling decision in another case, it was said that the allegations do not show, as a matter of law that no other legal conclusions could be reached that that the employee's injuries were the result of his failure to exercise ordinary care, or that by the exercise of such care the consequences of the employer's alleged negligence could have been avoided.

Engineers and Public Service

An Address Before American Engineering Council of the Federated American Engineering Societies Outlining Some of the Public Service Problems to Which the New Organization May Profitably Devote Its Attention

BY HERBERT HOOVER*

THIS federation of engineering societies, embracing the membership of between 50,000 and 100,000 professional engineers, has been created for the sole purpose of public service. This initial meeting surely warrants some discussion of a few of the problems to which this organization, for expression of the engineering mind, can quite well give consideration.

Some of the greatest of the problems before the country and, in fact, before the world are those growing out of our industrial development. The enormous industrial expansion of the last fifty years has lifted the standard of living and comfort beyond any dream of our forefathers. Our economic system under which it has been accomplished has given stimulation to invention, to enterprise, to individual improvement of the highest order, yet it presents a series of human and social difficulties to the solution of which we are groping. The congestion of population is producing subnormal conditions of life. The vast repetitive operations are dulling the human mind. The intermittency of employment due to the bad co-ordination of industry, the great waves of unemployment in the ebb and flow of economic tides, produce infinite wastes and great suffering. Our business enterprises have become so large and complex that the old personal relationship between employer and worker has to a great extent disappeared. The aggregation of great wealth, with its power of economic domination, presents social economic ills which we are constantly struggling to remedy.

NO MAN CAN DRAFT A UNIVERSAL PANACEA

I propose to traverse only a small fraction of these matters. I do not conceive that any man, or body of men, is capable of drafting in advance a plan that will solve these multiple difficulties and preserve the system which makes individual intiative possible. We have presented to us economic social patent medicines of one kind or another and, in fact, the great panacea of socialism is today in actual trial in its various forms. In Russia the attempt has been made to apply the most extreme form of complete communism. The Russian experiment is bankrupt in production. The populations of our modern states have been built up to numbers dependent upon an intensity of production that can be maintained only by stimulation of individual effort through the impulse of self-interest, and a departure from this primary incentive to production has now been demonstrated to lead only to famine and flame and anarchy. We have even had a gigantic experiment imposed upon the United States by the war in the necessity to operate a vast merchant marine at the hands of the Government, with a result that should offer little consolation to those who advocate even the mildest application of socialism.

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We have built up our civilization, political, social and economic, on the foundation of individualism. We have found in the course of development of large industry upon this system that individual initiative can be destroyed by allowing the concentration of industry and service, and thus an economic domination of groups over the whole. We have therefore built up public agencies intended to preserve an equality of opportunity through control of possible economic domination. Our mass of regulation of public utilities and of many other types of industry, aiming chiefly to prevent combinations in restraint of free enterprise, is a monument to our attempts to limit this economic domination—to give a square deal. This regulation is itself also proof of the abandonment of the unrestricted capitalism of Adam Smith. While our present system of individualism under controlled capitalism may not be perfect, the alternative offers nothing that warrants its abandonment. Our thought, therefore, needs to be directed to the improvement of this structure and not to its destruction.

GROWTH OF VOLUNTARY LOCAL AND NATIONAL ASSOCIATIONS

A profound development of our economic system apart from control of capital and service during the last score of years has been the great growth and consolidation of voluntary local and national associations. These associations represent great economic groups of common purpose, and are quite apart from the great voluntary groups created solely for public service. We have the growth of great employers' associations, great farmers' associations, great merchants' associations, great bankers' associations, great labor associations—all economic groups striving by political agitation, propaganda and other measures to advance group interest. At times they come in sharp conflict with one another, and often enough charge one another with crimes against public interest. And to me one question of the successful development of our economic system rests upon whether we can turn the aspects of these great national associations toward co-ordination with one another in the solution of national economic problems, or whether they shall grow into groups for more violent conflict. The latter can spell breakdown to our entire national life.

SERVICE SHOULD BE MOTTO OF ENGINEERS

This engineers' association stands somewhat apart among these economic groups in that it has no special economic interest for its members. Its only interest in the creation of a great national association is public service, to give voice to the thought of the engineers in these questions. And if the engineers, with their training in quantitative thought, with their intimate

experience in industrial life, can be of service in bringing about co-operation among these great economic groups of special interests they will have performed an extraordinary service. The engineers should be able to take an objective and detached point of view. They do not belong to the associations of either employers or labor, of farmers or merchants or bankers. Their calling in life is to offer expert service in constructive solution of problems to the individuals in any of these groups. There is a wider vision of this expert service in giving the group service of engineers to group problems.

We have just passed through a period of unparalleled speculation, extravagance and waste. We shall now not only reap its inevitable harvest of unemployment and readjustment but we shall feel the real effect of four years of world destruction, and from it economic and social problems will stand out in vivid disputation. One of the greatest conflicts rumbling up in the distance is that between the employer on one side and organized labor on the other. We hear a great deal from extremists on one side about the domination of the employer, and on the other about the domination of organized labor. Probably the tendency to domination exists among the extremists on both sides. One of the most perplexing difficulties in all discussion and action in these problems is to eliminate this same extremist. There are certain areas of conflict of interest, but there is between these groups a far greater area of common interest, and if we can find measures by which, through co-operation, the field of common interest could be organized, then the area of conflict could be in the largest degree eliminated.

Labor Organizations Bulwark Against Socialism

In this connection the employer sometimes overlooks a fundamental fact in connection with organized labor in the United States. This is that the vast majority of its membership and of its direction are individualists in their attitude of mind and in their social outlook; that the expansion of socialist doctrines finds its most fertile area in the ignorance of many workers, and yet the labor organizations, as they stand today, are the greatest bulwark against socialism. On the other hand, some labor leaders overlook the fact that if we are to maintain our high standards of living, our productivity, it can only be in a society in which we maintain the utmost possible initiative on the part of the employer; and further, that in the long run we can expand the standard of living only by the steady increase of production and the creation of more goods for division over the same numbers.

The American Federation of Labor has publicly stated that it desires the support of the engineering skill of the United States in the development of methods for increasing production, and I believe it is the duty of our body to undertake a constructive consideration of these problems and to give assistance not only to the Federation of Labor but also to the other great economic organizations interested in this problem, such as the Employers' Association and the Chambers of Commerce.

Three Chief Wastes of Production

It is primary to mention the three chief wastes in production: First, from intermittent employment; second, from unemployment that arises in shifting of industrial currents, and third, from strikes and lockouts. Beyond this elimination of waste there is another field of progress in the adoption of measures for positive increase in production.

In the elimination of the great waste and misery of intermittent employment and unemployment we need at once co-ordination in economic groups. For example, our engineers have pointed out time and again to the bituminous coal industry where the bad economic functioning of that industry results in an average of but 180 days' employment per annum, where a great measure of solution could be had if a basis of co-operation could be found among the coal operators, the coal miners, the railways and the great consumers. The combined result would be a higher standard of living to the employees, a reduced risk to the operator, a fundamental expansion of economic life by cheaper fuel. With our necessary legislation against combination and the lack of any organizing force to bring about this co-operation the industry is helpless unless we can develop some method of governmental interest, not in governmental ownership but in stimulation of co-operation in better organization.

In help against the misery in the great field of seasonal and other unemployment we indeed need an expansion and better organization of our local and federal labor exchanges. We have a vast amount of industry, seasonal in character, which must shift its labor complement to other industries. The individual worker is helpless to find the contacts necessary to make this shift unless the machinery for this purpose is provided for him.

Collective Bargaining

In the questions of industrial conflict resulting in lockouts and strikes one mitigating measure has been agreed upon in principle by all sections of the community. This is collective bargaining, by which, whenever possible, the parties should settle their difficulties before they start a fight.

It is founded not only on the sense of prevention but on the human right to consolidate the worker in a proper balanced position to uphold his rights against the consolidation of capital. This measure, advocated for years by organized labor, was agreed to by the employers' group in the First Industrial Conference. It has been supported in the platforms of both political parties. The point where the universal application of collective bargaining has broken down is in the method of its execution. The conflict arises almost wholly over the question of representation and questions of enforcement. The employer in some industries denies the right of men other than his own employees to conduct the negotiations. Labor organizations insist that as such negotiations require skill, experience and bargaining freedom they are of more than local application and that thus only can they protect the body of workers by presenting the case on their behalf by skilled negotiators.

The Second Industrial Conference, of which I was a member, proposed a solution to this point by the provision that where there was a conflict over representation the determination should be left to a third and independent party. It also proposed that each party should have the right to summon skill and experience to its assistance. It further proposed that where one of the parties at dispute refuses to enter upon collective bargaining the entire question should be referred to an independent tribunal for investigation as to the right and wrong of the whole dispute—but only for investi-

gation and report. That conference, embracing both a great employer and a most distinguished representative of organized labor, was completely convinced that the illumination of the public mind as to the rights and wrongs of these contentions would in itself make for material progress in their solution, and that in public education and the condemnation by public opinion of wrong-doing lay the root of real progress. No group should be afraid of authoritative publicity in these matters, and I believe it would greatly advance an understanding of the cause of labor. The conference did not believe that industrial contention could be cured by compulsory arbitration or any other form of governmental repression which must in the end use the jails for enforcement. The principles formulated by that conference should have your consideration.

Questions Deserve Careful Study by Engineers

There are questions in connection with this entire problem of employer and employee relationship, both in its aspects of increased production and in its aspects of wasteful unemployment, that deserve most careful study by our engineers. There lies at the heart of all these questions the great human conception that this is a community working for the benefit of its human members, not for the benefit of its machines or to aggrandize individuals; that if we would build up character and abilities and standard of living in our people we must have regard to their leisure for citizenship, for recreation and for family life. These considerations, together with protection against strain, must be the fundamentals of determination of hours of labor. These factors being first protected, the maximum production of the country should become the dominating purpose. The precise hours of labor should and will vary with the varying conditions of trades and establishments, but the proper determination of hours, based upon these factors, is an immediate field demanding attention of engineers. There is no greater economic fallacy than the doctrine that the decrease of hours below these primary considerations makes for employment of greater numbers, and it is an equal certainty that the 84-hr. week of some employments transgresses these fundamentals to a point of inhumanity.

Graded Added Compensation for Skill

There is a broad question bearing upon stimulation of self-interest and thus increase in production that revolves around the method of wage payment. I need not review to you the advantages, difficulties and weaknesses of bonus, piece work, profit- or saving-sharing plans that are in use as a remedy for the deadening results of the same wage payment to good and bad skill alike. The suggestion I wish to put for your consideration is the possible use of another device in encouragement of individual interest and effort by creating two or three levels of wage in agreements for each trade, the position of each man in such scale to be based upon comparative skill and character. This plan should be developed upon the principle of graded extra compensation for added skill and performance above an agreed basic wage. In order to give confidence the classification under such scales must be passed upon by representatives of the workers in such shop or department. This plan is now being successfully experimented with.

We must take account of the tendencies of our present repetitive industries to eliminate the creative instinct in its workers, to narrow their field of craftsmanship, to discard entirely the contribution to industry that could be had from their minds as well as from their hands. Indeed, if we are to secure the development of our people we cannot permit the dulling of these sensibilities. Indeed, we cannot accomplish increased production without their stimulation. Here again we cannot make an advance unless we can secure co-operation between the employer and the employee. In large industry this mutuality of interest that existed in small units cannot be restored without definite organization.

Shop Committees

There has been a great increase in shop committees as a method of such organization. Where they have been elected by free and secret ballot among the workers, where they are dominated by a genuine desire on both sides for mutual co-operation in the shop, they have resulted in great good. One of the most important phases of that good has been the tendency to turn the aspect of some foremen from that of slave-driving to leadership. And a great good has been possible by the encouragement of men to creative effort, in the stimulation of their minds as well as their hands to the solution of these problems. It makes for pride of craftsmanship and is a real effort to offer them an opportunity of self-expression. Organized labor has opposed some forms of these committees because of the fear that they may break down trade organization covering the area of many different shops. There is economic reason for this fear in certain cases, deeper than appears upon the surface.

One of the greatest accomplishments of organized labor has been the protection of the workers from the unfair employer, and it is worth the employer's notice that this is at the same time the protection of the fair employer from the unfair competition of the sweatshop. Again, I believe the engineers could assist in the erection of a bridge of co-operation if organized labor, which has already made a beginning, would extend more widely its adoption of the principles of a shop committee settling its problems of wage and conditions of labor in general agreement and applying its energies through shop committee organization to development of production as well as to the correction of incidental grievances. There would be little outcry against the closed shop if it were closed in order to secure unity of purpose in constructive increase of production by offering to the employer the full value of the worker's mind and effort as well as his hands.

Increased Production

There is an immediate problem in increased production that is too often overlooked by the theorist. While it is easy to state that increased production will decrease cost and by providing a greater demand for goods secure increased consumption and ultimate greater employment, yet the early stages of this process do result in unemployment and great misery. It takes a variable period of time to create the increased area of consumption of cheapened commodities, and in the meantime, when this is translated to the individual worker he sees his particular mate thrown out of employment. We accomplish these results over long periods of time, but if we would secure co-operation to accomplish them rapidly we must take account of this unemployment and we must say to them that if the community is to benefit

by the cheapening costs, and thus the increased standard of living, or alternatively if the employer is to take the benefits, the entire burden should not be thrust upon the individual who now alone suffers from industrial changes. Nor can this be accomplished except by co-operation between groups. In fact, the whole problem of unemployment needs earnest consideration.

Summary

In summary, the main point that I wish to make is this: that there is a great area of common interest between the employer and the employee through the reduction of the great waste of voluntary and involuntary unemployment and in the increase of production. If we are to secure increased production and an increased standard of living we must keep awake interest in creation, in craftsmanship and the contribution of the workers' intelligence to management. Battle and destruction are a poor solution of these problems. The growing strength of national organizations on both sides should not and must not be contemplated as an alignment for battle. Battle quickly loses its rules of sportsmanship and adopts the rules of barbarism. These organizations—if our society is to go forward instead of backward—should be considered as the fortunate development of influential groups through which skill and mutual consideration can be assembled for co-operation to the solution of these questions. If we could secure this co-operation throughout all our economic groups we should have provided a new economic system, based neither on the capitalism of Adam Smith nor upon the socialism of Karl Marx. We should have provided a third alternative that preserves individual initiative, that stimulates it through protection from domination. We should have given a priceless gift to the Twentieth Century.

I am not one of those who anticipates the solution of these things in a day. Durable human progress has not been founded on long strides. But in your position as a party of the third part to many of these conflicting economic groups, with your lifelong training in quantitative thought, with your sole mental aspect of construction, you, the engineers, should be able to make contribution of those safe steps that make for real progress.

Paper From Veneer Waste*

Raw material suitable for the manufacture of high grades of paper is found in wood wastes from veneer factories. The cores of many kinds of veneer logs, now used in large part for fuel, would make excellent pulpwood. In addition, a large part of the clippings and small veneer waste probably could be turned into pulp stock with profit.

Among the veneer woods whose waste has paper-making possibilities are red gum, yellow poplar, cottonwood, birch, tupelo, basswood and beech. Many veneer factories cutting these species are already within shipping distance of pulp mills: In certain other cases veneer factories are so grouped that they might furnish pulpwood enough to warrant the erection of a centrally-located mill. Other economic factors being favorable, such a mill could profitably operate on a daily supply of veneer waste equivalent to fifty cords of ordinary pulpwood. Of course, the construction of a mill should be undertaken only upon the advice of a competent mill engineer after a careful survey of local conditions.

*From *Technical Notes*, Forest Products Laboratory.

Cast-Iron Thermit Welds

Almost every day in various industries the question arises as to the feasibility of welding cast-iron sections of widely divergent sizes and shapes. The following explanation may therefore be of interest to those contemplating repairs of this nature:

In thermit welding the superheated steel produced by the reaction, when tapped into the mold surrounding the weld, fuses back into the fractured parts 2 or 3 in. on either side and the whole mass solidifying at one time effects the repair. The excess metal of the weld may then be removed or not, as the necessity indicates.

In cast-iron welding steel is the welding medium and the weld material will therefore necessarily consist of a mixture of this steel and the cast iron of the parts being welded. The graphitic carbon in the cast iron combines with the thermit steel, thus making a high-carbon steel which usually can be machined only by grinding. This material, however, is not so brittle as cast iron and is physically stronger.

In the second place, in considering thermit repairs of cast iron it should be borne in mind that the weld material is steel and therefore has double the shrinkage of the cast iron. This difference in shrinkage is of no importance where the section being welded is approximately square or equi-axed. Where, however, the length of the section at the fracture is four or five times its thickness this difference in shrinkage is evidenced by one or more minute cracks perpendicular to the line of the weld and extending through the weld material only. These cracks are naturally caused by the difference in shrinkage, the cast-iron parts tending to restrict the shrinkage of the steel along the length of the piece. Such hairline cracks will be found in the welding of sections such as, for instance, 12 x 24 in., but would not be found in sections 12 x 12 in. The cracks are often unimportant, as they are parallel to the line of strain.

The experience of the Metal & Thermit Corporation over a long term of years with literally thousands of cast-iron welds proves conclusively that where the length of a fracture is not more than four or five times its thickness and where the subsequent machining can be accomplished by grinding, a thermit weld can be made and will invariably be successful.

Foreign Trade of France for the First Nine Months of 1920

The total French foreign trade for the first nine months of 1920 amounted to 43,746,782,000 fr. (franc = $0.193 at the normal rate) against 31,271,637,-000 fr. for the corresponding period of 1919, reports Consul General Thackara of Paris. The imports of food products for the January-September period of 1920 were valued at 6,727,751,000 fr., against 7,413,563,000 fr. for the first nine months of 1919; industrial materials, 12,618,645,000 fr. against 9,542,226,000 fr.; manufactures, 7,842,675,000 fr., against 7,611,631,000 fr. The exports of food products amounted to 1,529,-501,000 fr. against 709,085,000 fr.; industrial materials, 3,661,821,000 fr., against 1,205,090,000 fr.; manufactures, 10,589,520,000 fr., against 4,174,361,000 fr.; and postal packages, 776,868,000 fr., against 615,681,000 fr. The adverse trade balance for the first nine months of 1920 was 10,631,360,000 fr., against 17,863,203,000 fr. for the corresponding period of 1919.

Some Deep-Etching Experiments on New Steel Rails

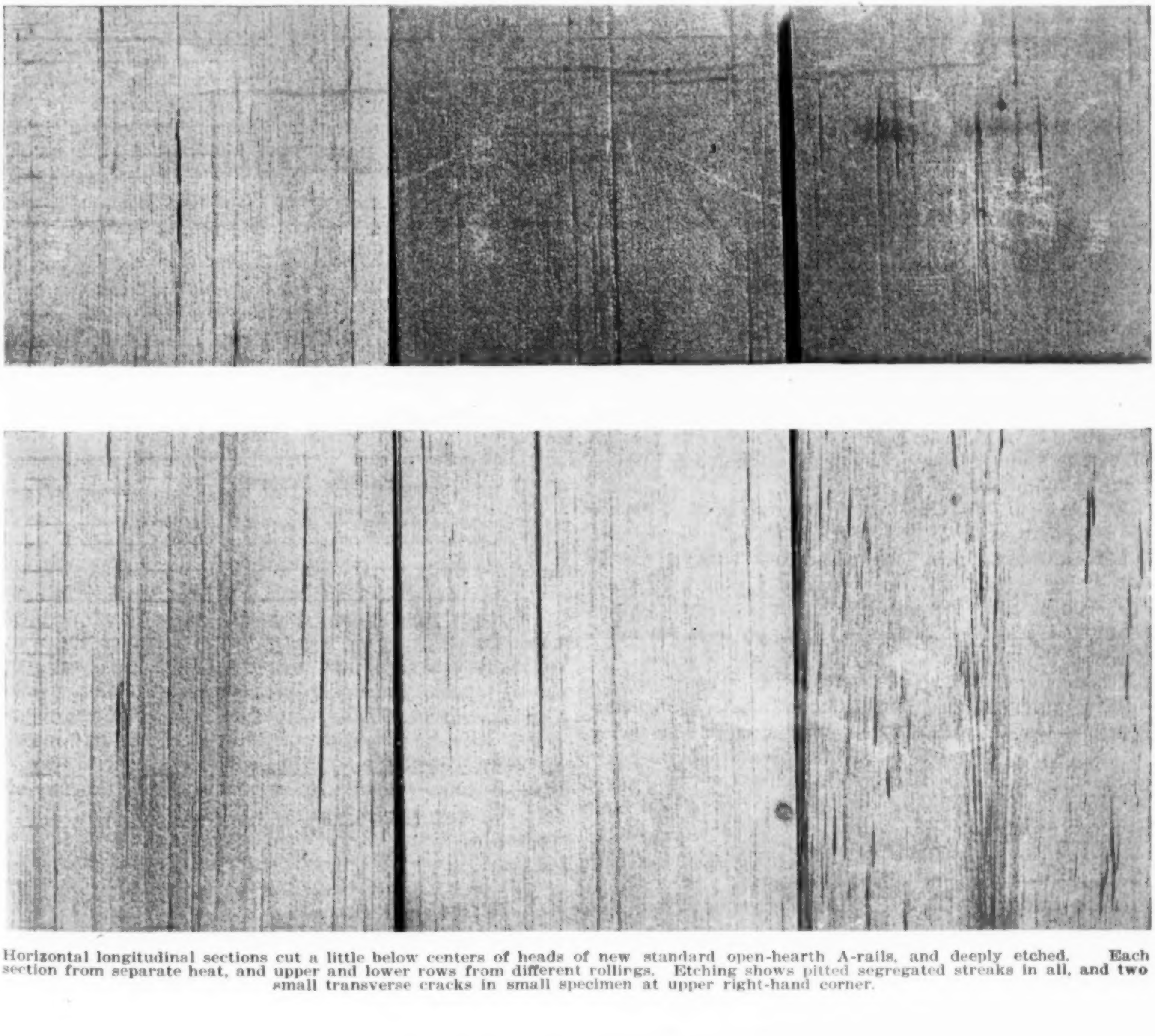
By George F. Comstock

IN VIEW of the interest that has been aroused recently in the subject of deep-etching of rails and the markings shown thereby, a few experiments were made with this method of etching on some of the large collection of new steel rails that have accumulated in this laboratory from previous work. Some facts were brought out by these experiments which, while possibly not of entirely general application, may nevertheless be worth publishing as affording an additional scrap of evidence on a point which has not received much attention in the numerous discussions of this etching method.

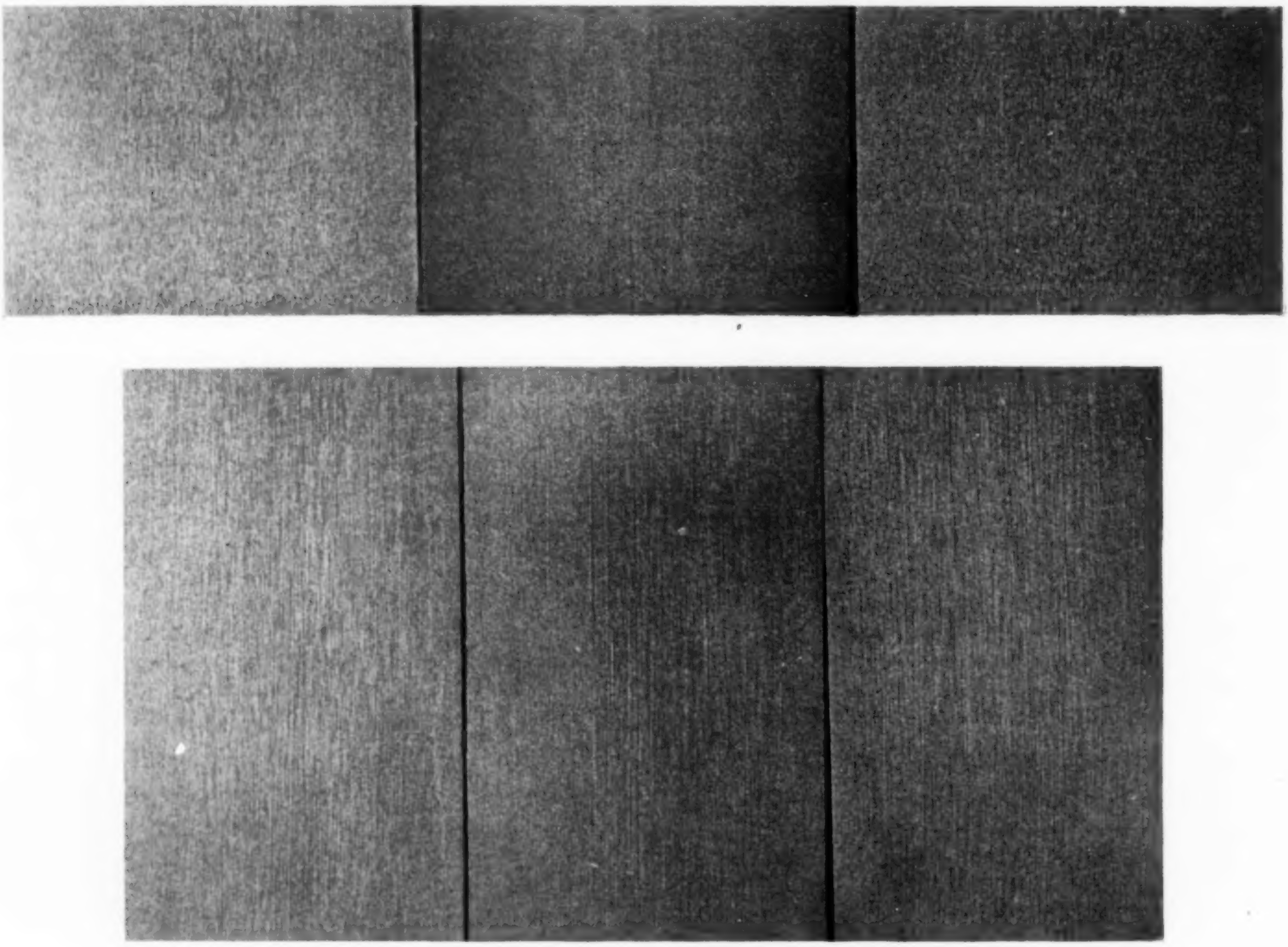
Most of the papers on this subject give the impression that the authors have considered all depressions, eaten out of a rail-section that was etched for several hours in strong hot acid, to be the result of pre-existing cracks or a shattered condition of the steel. Technologic Paper 156 of the Bureau of Standards, entitled "Metallographic Features Revealed by the Deep Etching of Steel," by H. S. Rawdon and S. Epstein, is an exception to the above statement, and a study of this comprehensive discussion of the subject shows that these authors appreciate the action of this etching on segregated streaks as well as its action on fissures or cracks. The statement has occurred several times in papers on this subject that the fissures or shattered condition have been found in new rails as well as in rails that had been in track, but no evidence has ever been seen by the writer as to the frequency with which this condition is met in new rails. It was decided, therefore, to examine some of the new rails in our large collection of samples, to see what we could find in them by deep etching.

The samples chosen were all hot-sawed sections of A-rails, half of them being rails made according to usual practice and more or less segregated, and half being titanium-treated rails having a uniform structure. Lengthwise sections 4 or 5 in. long were cut parallel to the base of the rail, and a little below the center of the head, and these were all boiled for several hours in strong hydrochloric acid, until their macrostructures were prominently developed. The etched sections were washed, dried carefully, and rubbed with a little oil to retard rusting, and were then photographed, with results as shown in the accompanying illustrations.

The homogeneous rails show sections free from any pits or markings except the lines due to the rolling out



Horizontal longitudinal sections cut a little below centers of heads of new standard open-hearth A-rails, and deeply etched. Each section from separate heat, and upper and lower rows from different rollings. Etching shows pitted segregated streaks in all, and two small transverse cracks in small specimen at upper right-hand corner.



Horizontal longitudinal sections cut a little below centers of heads of new titanium-treated open-hearth A-rails, and deeply etched. Each section from separate heat, and upper and lower rows from different mills. Etching shows rolled-out dendrites only.

of the original dendritic structure of the ingots. The ordinary segregated rails, however, show numerous deep streaks or elongated pits that are due not to any unsound or shattered condition of the steel, but merely to segregation of impurities, chiefly sulphur, which caused the metal in those streaks to dissolve faster. It is important that such segregated streaks should not be confused with cracks in the steel, yet the method of examination by deep etching gives the same indication for both kinds of defect.

The section illustrated in the upper right-hand corner of the photograph of the segregated rails shows two small transverse pits, one associated with a double segregated streak, and one apparently separated from any such streak. These could hardly be anything but enlarged cracks in the steel, so that we have here evidence of this condition occurring in a new rail that has not been in service. The twelve samples examined by deep etching do not probably constitute a sufficiently extensive test for a good determination of the frequency of occurrence of this defect in new rails, but we know at least that it was found in only one out of twelve subjected to deep etching, and indeed this is the only new rail in which such cracks were found out of about sixty new A-rails which have been exhaustively tested in this laboratory by various physical and metallographic methods. Thus it seems probable, from our work at least, that the shattered condition found so commonly in rails that developed transverse fissures in track is a very rare occurrence in new rails. Evidence on this point from those who have investigated it more extensively would be of considerable interest.

It might well be noted in this connection that since only one rail in a thousand develops transverse fissures, every transverse fissure might well be the result of shattered metal in a new rail, without any such defect being found in an investigation of only sixty representative rails. In other words, shattered metal in new rails may be quite a rare occurrence and still account for every case of transverse fissures.

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Europe's Sugar Production

In sugar production Germany has suffered perhaps more than any other country as a result of the war. Germany was the great sugar-producing area, but now she is unable to supply her own needs. Meanwhile Cuba has increased its output to still greater proportions, providing now about 90,000,000 hundredweight annually. The figures for sugar production in the principal European countries, as given in *The Review* of Oct. 15, 1920, are as follows:

Countries	1913-14 Cwt.	1919-20 Cwt.
Germany	54,766,000	15,000,000
Austria-Hungary	33,766,000	11,700,000
Netherlands	4,628,000	4,760,000
Sweden	2,744,000	2,900,000
Denmark	2,914,000	3,200,000
Belgium	4,580,000	2,540,000
France	15,620,000	3,500,000
Russia	33,760,000	7,000,000
Other countries	10.856 000	6.000 000

Wilmington and the Chemical Industry

Aside From the Well-Known Powder and Explosives Plants the Industrial Activities of Wilmington, Del., Include Such Chemically-Controlled Industries as: Cotton Goods Finishing; Glazed Kid Leather; Lithopone; Vulcanized Fiber; Pulp and Paper

MENTION of Wilmington, Del., invariably brings to mind the explosives industry, which is so highly developed in the district immediately surrounding the city. This instinctive association has become so strong that the extensive industrial enterprises in other lines are often lost sight of. Indeed, even many of the members of the Delaware Section of the American Chemical Society found at the conclusion of the regular meeting held Thursday evening, Nov. 18, that they had not fully appreciated the magnitude of the various chemically-controlled industries in the vicinity of Wilmington. The papers read at this meeting are given in abstract below.

The Finishing of Cotton Goods

Gray goods, as cotton goods are called as they come from the loom, must be finished to make them marketable. The cotton mills sell their product to merchants known as converters, who combine small orders so that the finishers are able to maintain quantity production. The operations involved in finishing cotton goods were outlined by D. S. Ashbrook, superintendent, Joseph Bancroft & Sons Co. This finishing plant is the largest single plant of its kind in this country, having a maximum production of 160,000,000 yd. per year.

After singeing and wetting out, the natural waxes and warp sizing are removed from the gray goods by boiling 9 to 12 hr. under 12 to 15 lb. steam pressure with a 3 to 4 deg. Tw. caustic soda solution in horizontal Mather & Platt kiers having a capacity of about 10,000 lb. of cloth per operation.

The cloth is then stretched on the mercerizing range—two parallel endless chains 75 ft. long made up of iron clips so arranged that the greater the tension the tighter the hold on the selvage of the cloth—and impregnated with 30 per cent NaOH solution at 50 to 60 deg. F. After washing, bleaching with sodium hypochlorite, and dyeing by the process best adapted to the type of dye used, the cloth is ready for finishing. The speaker chose a lining sateen as illustrative of the more than two hundred finishes used by this company.

Finishing Process

In the case of a lining sateen the sizing depends on the weight of cloth desired and on the finish. High-grade cloths are merely oiled to produce a suitable softness. Low-grade cloths are sized with starch and oil. Each of the common starches has peculiar properties of its own and gives a distinctive feel to the cloth. Wheat flour, wheat, corn, cassava, potato, sago and rice starches, corn and potato dextrines are used. The cloth is now stretched, smoothed out on a seven-roll calender and satin finished on a hydraulic schreiner having a steel roll, engraved with fine diagonal lines (250 per in.), which is forced against the face of the cloth by a pressure of 30 to 45 tons at a temperature of 300 to 400 deg. F. The final operation consists in breaking up any hardness in the finish by steel blades or rollers set with brass-headed tacks.

Manufacture of Glazed Kid Leather

It is not ordinarily realized that with the exception of North America practically the whole world regards the goat as an important source of meat and milk. About 100,000,000 raw goatskins are obtained every year, chiefly from India, China, Europe, Africa, South America and Mexico. Of these about 50,000,000 are sent to the United States, a single company tanning 12,000,000 skins. The manufacture of glazed kid from these skins was described by F. J. Blatz, plant superintendent, Amalgamated Leather Co. Wilmington and Philadelphia produce 80 to 90 per cent of the glazed kid in this country.

Beam House Processes

The dry or salted skins are soaked in water, trimmed and treated with lime liquor from 8 to 12 days. The hair and flesh are removed on dehairing and fleshing machines and the excess lime is removed by bating with oropon. On slating machines dull revolving slates are brought into contact with the grain of the bated skins and pull out all dirt and fine hair, clearing the skins for tanning.

Tanning

In tanning goatskins the two-bath chrome process is used almost exclusively. The skins are placed in a solution of sodium bichromate acidified with hydrochloric acid. The next day the skins are bright yellow in color, but are not tanned, since the yellow color can be removed by washing in water. By immersing in a solution of sodium hyposulphite acidified with HCl the chromic compounds are reduced and combine with the skin to form leather. Only two days are required for this process. A portion of the free sulphur liberated from the sodium hyposulphite is apparently also taken up by the skin, since the results are superior to those obtained by using sodium bisulphite. About 1 lb. of sodium bichromate is required for 1 doz. skins. Water is now removed on striking-out machines and the skins are shaved on the flesh side. Unless this were done the backbone, which is thicker than the rest of the skin, would show as a black line on glazing.

Coloring

The skins are weighed and placed in revolving drums with suitable dyes and vegetable extracts, the majority being made into brown and black leather. After coloring the skins are given a bath of fat liquor, compounded of soap, oils and egg yolk. These substances give the leather its soft feel. This is followed by stretching on a putting-out machine, and oiling off with a thin coat of neatsfoot oil and glycerine, which holds the grain fine and silky. Drying brings the skins to the "crust" condition—that is, hard and stiff. They

are piled in cool rooms for a week, dampened with water and put through a staking machine which loosens all the fibers.

FINISHING

The skins are now in a soft, pliable condition. They are given a coating of egg albumen, and gum, blood and nigrosine are usually added to brighten the gloss and blacken the grain. The glaze is produced on the dried skins by the friction of a moving agate cylinder and a stationary leather strap. Three coatings and glazings are usually required.

Measuring, sorting and bundling complete the process.

Lithopone

A paper on the manufacture and uses of lithopone, prepared by A. S. Krebs, treasurer, Krebs Pigment & Chemical Co., was read by Donald Ross, chief chemist.

The manufacture of lithopone is divided into three steps: The production of a pure barium sulphide solution; the preparation of a pure zinc sulphate solution; the manufacture of lithopone from these two solutions.

BARIUM SULPHIDE SOLUTION

The most important raw material is barytes. This is now obtained chiefly from Georgia, although some has gone into the lithopone business from Tennessee and Missouri. The ore deposits of Georgia can be worked satisfactorily with a steam shovel, whereas most Tennessee and practically all Missouri deposits are so small that they are mined by pick and shovel.

Barytes as received at the factory is crushed, mixed with coal and burned at 1,200 to 1,300 deg. C. from 2 to 3 hr. in rotary kilns. The black ash formed is leached, giving a solution of barium sulphide.

ZINC SULPHATE SOLUTION

In the manufacture of zinc sulphate any form of zinc or zinc oxide such as skimmings, zinc ash from galvanizing kettles, impure oxides or zinc carbonate ores may be dissolved in sulphuric acid. Zinc sulphide or roasted zincblende may also be used. The resulting solution is purified by various oxidizing processes, depending on the nature of the liquor.

LITHOPONE

By mixing proper proportions of the zinc and barium liquors, lithopone is precipitated. Plate and frame presses or Oliver continuous filters are used in filtering the pigment and the cake is dried and fed into muffle furnaces heated to about 500 deg. C. When uniformly heated the material is raked out, quenched in water and ground to remove grit due to sand from the furnace walls or to the sintering of overheated particles of lithopone. The ground pulp is washed, filtered, dried, pulverized, sometimes air floated, and packed in barrels of 400 lb. or bags of 50 lb.

USES OF LITHOPONE

Lithopone is peculiarly well adapted to the manufacture of paints for interior work, such as flat wall paints with chinawood or soya bean oil vehicles and mill whites. In whiteness it is surpassed only by the finer grades of zinc oxide. It has a low oil figure—that is, there can be incorporated in a gallon of oil more pounds of lithopone than zinc oxide. Partly due to this reason and partly to its capacity, lithopone paints have excellent covering power. Indeed, in this respect it is probably the best pigment.

When lithopone is properly compounded with sublimed lead or zinc oxide and appropriate vehicles, an excellent outside paint results, the use of which is rapidly increasing.

Large quantities of lithopone are also used in the rubber industry, in the manufacture of linoleum, wall paper, window shades and printing inks. The lithopone industry has grown from 920 tons in 1900 to a production of 79,619 tons in 1919, and it is expected that the 100,000-ton mark will be reached in 1920 or 1921.

Vulcanized Fiber

The manufacture, properties and uses of vulcanized fiber were discussed by Jay Robinson, of the American Vulcanized Fibre Co. The annual production of vulcanized fiber in this country is about 20,000,000 lb., about 60 per cent of which is made within a radius of twelve miles of Wilmington.

MANUFACTURE OF VULCANIZED FIBER

Cotton rags are the chief source of the fibrous materials used, although cotton hull, cotton linters and other materials are not uncommon. From these a special porous paper is made without sizing or loading. For best results, the fibers must be long and uniform. Consequently, cotton linters, which are short-fibered and knotty, do not make a satisfactory paper. While new rags are used largely in making writing paper, bookpaper, etc., old rags are preferred in the manufacture of fiber paper, as they are softer than new rags. It seems that the older and dirtier the rags are when received at the mill, the better paper they make.

Rolls of the special paper are now made into vulcanized fiber by passing the paper sheet over heated cylinders, through a bath of zinc chloride maintained at about 70 deg. Bé. and 100 deg. F. It is then rolled up over large heated drums to the desired thickness. The zinc chloride hydrolyzes the cellulose and gelatinizes the surface to such an extent that the paper unites and forms an almost homogeneous mass.

The "green" fiber is then washed in zinc chloride baths of progressively diminishing concentration until it is commercially pure—that is, contains less than 0.15 per cent chlorine. This process is of necessity very slow and any attempts to expedite it are likely to result in an inferior grade of fiber, or in blisters due to increased osmotic pressure. Three to four weeks are required to wash $\frac{1}{4}$-in. fiber, while 2-in. fiber takes six to eight months. The wet, pure fiber is dried to 8 per cent moisture at 100 to 160 deg. F., pressed and calendered. Vulcanized fiber contains from 5 to 8 per cent ash.

PHYSICAL AND MECHANICAL PROPERTIES

The finished product, which has shrunk to about one-half its original thickness, is a homogeneous material with a perfectly smooth, even surface that readily takes a high polish. No ordinary force will crush, break or split it. It can be turned, tapped, threaded, drilled, stamped, cut, sawed, riveted, embossed and bent, but it cannot be molded. The material is resilient, fire-resisting and has a low coefficient of friction. It does not rust, corrode or deteriorate with age like metal, does not scar like leather and does not have the weaknesses of wood.

Vulcanized fiber is not waterproof, but immersion in hot or cold water does no harm, as it resumes the original dimensions and properties on drying. By

special treatment, vulcanized fiber can be made sufficiently moisture-proof for ordinary use. Neutral salts, solvents and oils are without effect, but mineral acids cause disintegration in time.

It is possible to vary the mechanical and physical properties within fairly wide limits by proper manipulation of the chemical treatment or by varying the quality of the original paper. For this reason, care should be exercised in the selection of the proper grade to suit particular requirements. The two chief grades are hard and flexible. Pliability is secured in the latter grade by calcium chloride or glycerine treatment. Hard vulcanized fiber is most extensively used for mechanical purposes and as an insulator in dry places by manufacturers of electrical equipment.[1]

A comparison between some of the properties of vulcanized fiber and other materials is given in Table I.

TABLE I. SOME PROPERTIES OF VULCANIZED FIBER

Scleroscope Hardness	
Vulcanized fiber	25 to 50
Copper	15
Bessemer steel	26.6
Cast iron	33.3
Tool steel	37.8
High carbon steel	86.1

Tensile Strength	Lb. per Sq.in.
Vulcanized fiber	8,000 to 13,000
Zinc, cast	4,000 to 6,000
Tin	4,000 to 5,000
Porcelain	1,800
Aluminum, cast	11,000 to 16,500
Aluminum, rolled	16,500 to 22,400

Compressive Strength	Lb. per Sq.in.
Vulcanized fiber	33,000 to 43,000
Tin	6,400
Aluminum, cast	12,000
Granite	19,400
Marble	12,700
Paving brick	10,000
Porcelain	15,000
Copper, cast	39,000 to 48,000

Dielectric Strength	Volts per Mm.
Vulcanized fiber	6,000 to 16,000
Asbestos paper	4,000
Porcelain	9,000 to 16,350

The initial cost of vulcanized fiber is slightly more than that of mica, porcelain, glass, wood, leather, hard rubber and various metals, but on account of its longer life it is more economical in the end. Sheets are supplied from 0.005 to 2 in. thick, in widths and lengths up to 48 x 80 in.; rods and bars $\frac{1}{32}$ to 2 in. thick by 72 in. long; tubes $\frac{1}{8}$ to 6 in. inside diameter by $\frac{1}{4}$ to $6\frac{3}{4}$ in. outside diameter by 30 in. long; rolls from 0.005 to 0.025 in. thick.

Uses of Vulcanized Fiber

As insulation, vulcanized fiber is found everywhere. It makes noiseless, oil- and current-proof gears and pinions. When meshed with metal, such gears will increase the life and efficiency of the whole gear train. Vulcanized fiber valves have given continuous service for over three years in feed water pumps, pumping hot water at 212 deg. F. against 150 lb. pressure. Because of its unusual wearing qualities, vulcanized fiber is being used for mechanical parts such as friction disks and washers, bushings, bearings, brake shoes, gaskets, packings, wheels, etc.

However, in spite of its wide usage, in practically every plant there are countless places where more expensive and less serviceable materials are still being used.

Paper Making in Wilmington

Some notes on paper making in Wilmington were presented by J. H. Plumstead, superintendent, Delaware Mills, Jessup & Moore Paper Co.

The first machine-made paper in the United States was manufactured during the early part of the nineteenth century in a small mill at or near the site of the present Augustine Mill of the Jessup & Moore Paper Co. on a cylinder machine invented by the owner of the mill. While this invention is the greatest single event in the history of paper making to which Wilmington can lay claim, it may be stated in a general way that this entire vicinity has been very closely identified with paper making from the time paper was entirely handmade down to the present day.

The more important grades of paper may be conveniently classified according to use as follows:

Grades of Paper

Newsprint is a mixture of unbleached ground wood and sulphate or sulphite process wood pulp with a small amount of china clay to give opacity and weight and some ultramarine to offset the yellow cast of the unbleached fiber. Newsprint stock receives little mechanical treatment or beating before going to the paper machine.

Book, magazine, litho and the cheaper writings are made from soda, sulphate or sulphite process wood pulp bleached, loaded with china clay to give weight, beaten more than newsprint, tinted or left natural as desired, and sized with glue, casein, rosin, starch, dextrine or parchmentizing chemicals to make the sheet impervious to ink. The paper may be calendered by passing it over heated rolls or surface coated and calendered.

Wrapping and tissues are usually made from wood fiber produced by chemically treating a long-fiber wood just enough to break down the cementatious materials. The fibers are not bleached and loading, sizing and coloring matters are not usually added.

High-grade writings, bonds, ledgers and all papers that are sold with the thought that they may be kept for many years are made from cotton fiber itself—that is, from selected rags and cuttings. The mechanical treatment is very similar to that used on book paper.

Future of Wilmington's Paper Industry

Mr. Plumstead outlined the sources of the raw material—cellulose—the operations involved in converting this into paper, and said in conclusion that some of the enormous plants built on sites where water power and timber abound were on the verge of shutting down because, having exhausted the raw material near at hand, they have neither navigable waters nor good railroad facilities to fall back on. Not so with Wilmington. A railroad center with a waterfront which is constantly being improved, raw material supply and markets linked in a way that cannot but make for growth and long industrial life, Wilmington's future in pulp and paper making bids fair to be brilliant.

Pacific Roofing Co. Experimenting on Wallboard

The Pacific Roofing Co. has developed a magnesite quarry on the Pacific Great Eastern Ry., erected an experimental plant for the manufacture of wallboard from sawdust, calcined magnesite and magnesium chloride, and has on exhibition in Vancouver a supply of the finished product, which has attracted considerable attention. The company will erect in the vicinity of Vancouver a magnesite calcining plant capable of treating 5,000 tons of magnesite and of producing 12,500,000 ft. of wallboard annually.

The new industry is somewhat in the nature of an experiment, but if there is a demand for the material the size of the plant will be increased.

[1]See "Vulcanized Fiber," by Charles Almy, Jr., MET. & CHEM. ENG., vol. 13, p. 746, Oct. 15, 1915, and "Electrical Properties of Vulvanized Fiber," by William Eves, 3d, *Electrical World*, vol. 71, p. 190, Jan. 26, 1918.

A. C. S. Intersectional Meeting of Chicago and Milwaukee Sections

ON INVITATION from the Milwaukee Section the members of the Chicago Section of the American Chemical Society visited Milwaukee the afternoon and evening of Nov. 20. The meeting was called at the Milwaukee Athletic Club.

Dinner was served in the club grill, followed by the evening program. This took the form of an industrial symposium under the direction of W. Lee Lewis, and John Arthur Wilson opened with the following paper:

Theory vs. Practice and Trade Secrets From the Viewpoint of the Industrial Chemist

Since the development of both science and industry is materially assisted by free discussion, it is rather disconcerting to a young enthusiast to find his fellow industrial chemists holding theory in mild contempt and refusing to discuss practice for fear of divulging trade secrets. Although this unwillingness on the part of the industrial chemist to discuss either his science or practice is gradually disappearing, it is still sufficiently widespread to warrant an investigation into the cause.

Often a young chemist leaves school to enter one of the more complicated chemical industries, say that of leather manufacture, where he finds his training in theoretical chemistry of very little immediate value because of its inadequacy to deal with the behavior of the several hide proteins under the conditions of liming, bating, pickling, tanning, fatliquoring and dyeing. If he does attempt to institute a change for the better in one of these operations, the probability is that the stock on which the change is made will be damaged, if not totally ruined. In contrast, he sees an army of unschooled men turning out an unexcelled product. Before he can become of any great value to his firm he must either greatly extend his knowledge of chemistry to cover the tanning operations, or else master the art as conducted in the plant. He really should do both, but he too often feels compelled to give up the pursuit of theoretical chemistry in order to get quicker results by devoting all of his time to plant operations. The advance of science soon leaves him behind and he becomes more and more reluctant to enter theoretical discussions because of the fear, perhaps only subconscious, that a display of ignorance will injure his reputation.

Having become a practical man, however, he can scarcely avoid being drawn into discussions of practice occasionally, and he can often add many facts to such a discussion as, for example, that increasing the salt content of a given liquor produces certain unexpected results. But when an explanation of the phenomenon is sought, involving theoretical chemistry, a most embarrassing situation would follow were it not for the invention of the magic words "trade secret." As soon as he feels himself getting into deep water, he has only to express regret at not feeling free to go more deeply into the discussion, and his reputation is saved. The term "trade secret" is doubly useful, for it not only hides one's ignorance, but actually tends to create a sensation of wonderment.

The remedy is to make it clear to young men leaving school that sound development of a chemical industry requires a knowledge of the basic principles underlying the several processes and that, while it is essential to master the practice of the industry, it is also essential to seek to explain every operation, and this requires the vigorous pursuit of theoretical chemistry far beyond anything learned at school. While the man who follows this advice may seem to make less headway during the first year than his more practical brother, in the long run he will probably reach a goal entirely out of reach of the man whose theoretical training stops with his graduation.

Industries differing widely in practical procedure are governed by the same physical and chemical laws and the derivation of fundamental principles furnishes a common ground for work and discussion by chemists in every walk of life. With the majority of industrial chemists keeping pace with theoretical chemistry, there would be little need to resort to subterfuges to avoid discussions and the term "trade secret" would become as rare as the thing which it signifies.

Discussion

Otto Eisenschiml described a meeting of foremen and superintendents he had attended some time ago where it was intended to interchange trade secrets of the linseed oil industry. Each one present was asked to write down his best secret and inclose it in a sealed envelope. When the envelopes were later opened fifty of the formulas were found to be identical. At a similar informal meeting of varnish makers the pertinent discovery was made that they were all familiar with the same procedure in manufacture.

Paul Van Cleef and Mr. Nash believed in the need for secrecy, not so much of chemical formulas, but in mechanical methods of preparation.

Dr. Leech, speaking from the viewpoint of the medical profession, said there was nothing of greater handicap to public health than the trade secret. Medical formulas surrounded by deep secrecy and mysticism used in patent medicines, and for which marvelous curative properties are claimed, work untold damage to the well being of the public.

Dr. Redman spoke for the new industries on the firing line of research, where industrial application of new discoveries involve trade secrets of immense money value. Such research findings as connot be patented must here be kept secret. Speaking of the established industries, we should break the ice, interchange information and do away with the autocratic foreman.

Other speakers, including Messrs. Kadish and Prentiss, were in favor of the general interchange of information between industrial chemists and managers.

Mr. Prentiss made the speech presenting, in behalf of the members, a gold A.C.S. pin to John Arthur Wilson, chairman of Milwaukee Section, for his competent leadership of the work during a most successful year. He touched briefly on the co-operation with the Mayor's office, the city library and the review of the report for the city on the new $5,000,000 water and sewage project.

While the foregoing paragraphs may cover the serious facts of the meeting in brief, the measure of high spirits and good comradeship cannot be expressed in the space available. Many hearty informal talks of good will and joint interests interspersed with the above made the occasion one of close communion. Close acquaintances, old and new, talked far into the night at the club quarters where the visiting members were entertained. Another intersectional meeting was promised at Chicago in the near future. Among the ladies present were Mrs. L. V. Redman, Mrs. W. Lee Lewis of Chicago and Mrs. S. E. Layman of Milwaukee.

Current Events
in the Chemical and Metallurgical Industries

Chemical Manufacturers to Meet Entomologists

Chemical features of boll weevil control are to be discussed at a series of meetings which will begin in New York, Dec. 6, of manufacturers of arsenates, entomologists and representatives of cotton growers. The conferences are under the auspices of the Crop Protection Institute. The organization of this institute is just being perfected by the National Research Council.

Dusting the cotton plant with arsenates has proved to be the most promising method of boll weevil control. One of the purposes of the conferences is to standardize the arsenates. The intention is to acquaint the manufacturing chemists with the machinery used in applying the arsenates. Attention also is to be given to standardization of the machinery.

This is the type of work to be undertaken by the newly formed Crop Protection Institute. Since chemists play an important part in the eradication and control of insect and fungus pests it is expected that they will have an important part in the work done by the new institute. In fact, G. R. Cushman, of the General Chemical Co., headed the committee which recommended the formation of the Crop Protection Institute. The trustees of the institute are chosen from entomologists, manufacturing chemists, phytopathologists, and a representative of the National Research Council. Mr. Cushman, F. O. Moburg of the Rex Chemical Co. and P. W. Pickard of the Bowker Insecticide Co. are the trustees representing the chemical industry.

Technical Men of Baltimore Organize Engineers' Club

For some time past the technical men of Baltimore and vicinity have felt the need of a central meeting house or club where meetings could be held and where it would be possible to combine the meeting place with the usual facilities of a club. The rapidly increasing number of engineers, chemists and other technical men employed in Baltimore has made it difficult for the various organizations to hold their meetings in quarters sufficiently large to take care of joint meetings of these societies, and much thought has been given to the question of improving the facilities of the city in this way. Therefore the various organizations have decided to back a new enterprise, to be known as the Engineers' Club of Baltimore. The club will be located in the new Merchants and Manufacturers' Building at the corner of Light and Redwood Sts.

The members of each of the technical associations and societies which have chapters or sections in Baltimore will have the privilege of becoming members of the club, and each organization will be able to hold its meetings in the lecture theater in the club building. The clubrooms, other than the lecture theater, will be a library, reading room, billiard room and dining room. In addition special arrangements have been made with one of the adjacent hotels to provide sleeping accommodations for members of the club or their guests.

Annual Meeting of the American Society of Mechanical Engineers

The American Society of Mechanical Engineers will hold its forty-first annual meeting Dec. 7 to 10, 1920, at the Engineering Societies Building, 29 West 39th St., New York City. The tentative program for the technical sessions is:

Tuesday Afternoon, Dec. 7.—Fuel, Forest and Machine Shop Sections.

Wednesday Afternoon, Dec. 8.—Management, Railroad, Design and Research Sections.

Thursday Forenoon and Afternoon, Dec. 9.—Keynote session on Transportation and second meeting of the Research Section.

Friday Forenoon, Dec. 10.—Design, Textile and Power Sections.

Among the many papers to be presented are:

Fuel Supply of the World, by L. P. Breckenridge.

Low-Temperature Distillation of Coal, by O. P. Hood.

Fuel Conservation, by D. M. Myers.

Processes and Equipment Used in Wood Preservation, by E. S. Park and J. M. Weber.

Principles of Industrial Philosophy, by W. N. Polakow.

The Heat-Insulating Properties of Cork and Lith Board, by A. A. Potter, J. P. Calderwood, A. S. Mack and L. S. Hobbs.

Effect of Fittings on Flow of Fluids Through Pipe Lines, by D. E. Foster.

Textile Fabrics for Mechanical Purposes, by J. W. Cox.

Papers on Future Power Development:

- The Policy of Future Power Development.
- Effect of Load Factors on Cost.
- Effect of Size of Plant on Cost.
- Financial and Legal Aspects of Future Power Development.

Mining and Metallurgical Society to Be Formed at Utah University

Plans for the formation of a mining and metallurgical society at the University of Utah have been completed, according to Prof. R. S. Lewis. Membership will be restricted to sophomores and upper class men taking mining, metallurgical, chemical and geological courses, as well as professors in those departments, and officials and employees of the United States Bureau of Mines located at the university. The society will petition the American Institute of Mining and Metallurgical Engineers for a student chapter.

Still Looking for Chemical Director for C.W.S.

The search for a chemical director for the Chemical Warfare Service is continuing, but as yet no one has been found who is willing to take the responsibilities of this position for the $10,000 salary which is offered. Chemists with the qualifications which General Fries deems requisite are being paid higher salaries in private employment. Pending the selection of a director, Captain D. B. Bradner of the chemical staff at Edgewood Arsenal is made acting chemical director.

Association of Official Agricultural Chemists Meets

The Association of Official Agricultural Chemists met in Washington Nov. 15 to 17, at which time numerous committee reports were received regarding methods for valuation of agricultural, fertilizer, drug and food materials. At this meeting it was announced that the publication has been completed of "Methods of Analysis," which is now available for sale by the secretary, box 744, Eleventh St. Station, Washington, D. C. The *Journal* of the association will present the proceedings of the meeting in full in the near future, as this publication is now appearing again regularly.

Officers for the coming year include: President, W. F. Hand, Agricultural College, Mississippi; vice-president, F. P. Veitch, Bureau of Chemistry, Washington, and secretary-treasurer, C. L. Alsberg.

Referees on subjects of industrial chemical interest are as follows: Insecticides and fungicides, J. J. T. Graham, Bureau of Chemistry, Washington; fertilizers, R. N. Brackett, Clemson College, South Carolina; borax in fertilizers, W. H. Ross, Bureau of Plant Industry, Washington; preparation of ammonium citrate, C. S. Robinson, East Lansing, Mich.; nitrogen in fertilizers, I. K. Phelps, Bureau of Chemistry, Washington; potash availability, A. G. McCall, College Park, Maryland.

Important committees appointed were as follows: Vegetation tests on the availability of phosphoric acid in basic slag—H. D. Haskins, Agricultural Experiment Station, Amherst, Mass., chairman; C. B. Williams, W. B. Eliott, B. L. Hartwell and J. A. Bizzell. Committee to co-operate with A.S.T.M. on standards for and methods of testing agricultural lime—W. H. McIntire, Knoxville, Tenn., chairman; William Frear and F. P. Veitch. Committee on quartz plate standardization and normal weight for sugar—F. J. Bates, Bureau of Standards, Washington, chairman; C. A. Browne and F. W. Zerban.

Objection to Official Methods for Phosphoric Acid Determination

H. P. Nelligan, of the American Glue Co., presented before the Association of Official Agricultural Chemists certain important objections to the present official methods of analysis for determination of phosphoric acid in commercial materials largely used as fertilizers. He stated his objections as follows:

> The American Glue Co. produces dicalcium phosphate as a byproduct in the manufacture of osseine. This product is sold and valued on the market for fertilizer purposes acccording to its content of citrate soluble phosphoric acid as determined by the method prescribed by the Association of Official Agricultural Chemists. This method is not applicable to our product, which is a comparatively pure dicalcium phosphate. The official method was undoubtedly designed for a mixed fertilizer, and in all probability never more than 500 lb. of our product would be used in a fertilizer mixture. Now, in such a case, the charge to be weighed out for the determination of insoluble phosporic acid would contain (in the mixture) only ½ g. of the dicalcium phosphate, which would no doubt give full credit for all of the available phosphoric acid present. It is the consensus of opinion of all chemists who have done any considerable amount of work on this product that the present method is manifestly unfair, for when the material is mixed with other fertilizers it gives a higher availability in proportion than does the raw material, yet no provision has been made by the association to take care of this condition. . . .
>
> We have always been under the impression that the object of the Association of Official Agricultural Chemists was to secure uniformity and accuracy in the methods of analysis, yet the official methods in this case inflict an unjust penalty upon the American Glue Co. These conditions were brought to the attention of the Association three years ago, and during this time the American Glue Co. has stood a considerable loss on this product.
>
> We produce each year about 2,500 tons of this material. It is safe to assume that if the official method of analysis for this product was amended so that a 1-g. charge was used with 100 c.c. of ammonium citrate instead of the official 2-g. charge, we would gain in the vicinity of 2 per cent available P_2O_5 on all our production. The dicalcium phosphate is sold at so much per unit citrate soluble P_2O_5. At the present market value, we stand a loss of between $5,000 and $6,000 a year on this discrepancy in the present method of analysis.

The referee of the association on available phosphoric acid in precipitated phosphates, H. D. Haskins, reported his investigations on this matter in the following language:

> Your referee is convinced that the present official method for the determination of available phosphoric acid does not give full justice to this class of material and he would, therefore, recommend:
>
> That the determination of insoluble phosphoric acid in precipitated phosphate be carried out according to the present official method for the determination of insoluble phosphoric acid in fertilizers with the exception that a 1-g. charge be employed and that a quality of filter paper corresponding to C.S. & S. No. 597 be used together with perforated platinum cone and gentle suction in the filtration of the citrate solution after treatment.

Neutral Ammonium Citrate Solution

The composition and preparation of a neutral solution of ammonium citrate was discussed by C. S. Robinson. He recommends as a solution for use in the determination of phosphoric acid one which contains NH_3 and $C_6H_8O_7$ in the ratio of 1 to 3.794. He also recommends certain methods for the preparation of this solution which are the result of investigation as to the significance with respect to hydrogen ion concentration of solutions prepared by different methods. It is evident that that measure of neutrality is very important as affecting the apparent phosphoric acid content of this type of fertilizer material.

The committees of the association will study this subject further in collaboration with the industries affected.

Wisconsin University Revises Chemistry Work

A revision of the courses of the chemistry department of the University of Wisconsin has just been completed with the purpose of meeting a need for greater specialization in this profession. A greater number of elective college subjects outside of chemistry are required under the new ruling, as a part of the special courses, in order to give the student more cultural training. In the freshman year mechanical drawing has been made a required subject and mathematical chemistry is required in the sophomore year. In the general course industrial chemistry is required of all students.

Another new ruling is that at least one industrial trip must be taken during the course. The department also urges that each student obtain summer employment in his particular branch of chemistry so that he can bring to his theoretical studies the appreciation of their practical application.

During the coming year a general course, a course for industrial chemist, a course for food and sanitary chemist and a course for agricultural chemist are to be offered by the chemistry department. The courses for physiological chemists and for soils chemists have been dropped because of insufficient demand.

Special Service by Chemists' Club Library

Some time ago the Chemists' Club asked the co-operation of industrial chemical concerns in the support of a special service in the Chemists' Club library. This request met with a generous response and the library committee now announces to all who co-operated with the club that the services of Dr. M. A. Graham have been secured for this work. Dr. Graham will give her time exclusively to the answering of requests for special information, compiling of special reports and bibliographies, and will be available to render every possible assistance to employees of our subscribers in searching the literature. Work of this kind requires very broad chemical training, which requirement is well fulfilled by Dr. Graham. All work of this kind done for subscribers will be treated entirely confidentially. No charge will be made for work of this kind except in special instances where considerable time is required, in which case merely a nominal charge will be made.

Important Rulings on Petroleum and Natural Gas Passed in Canada

Two important orders in council have been passed by the Canadian Government. One provides that petroleum and natural gas regulations applicable to dominion lands shall be extended to certain portions of the forest reserves in order that an opportunity may be given to test these lands with a view to discovery. The other provides that for a period of five years after the date upon which the Minister of Interior shall declare that oil in commercial quantities has been discovered on crown lands, acquired under regulations governing such lands, the royalty to be exacted by the crown shall not exceed 5 per cent of the output of the well on sale of the product of the locations, nor be less than $2\frac{1}{2}$ per cent, and for the following five years it shall not be more than 10 per cent nor less than 5 per cent. After the ten-year period it shall be 10 per cent.

This applies only to the Provinces of Alberta, Manitoba and Saskatchewan, and the Yukon and Northwest territories. In the other provinces the oil rights are vested with the provincial governments.

Chemical and Fertilizer Tonnage

Chemicals and explosives to the extent of 2,038,223 tons were carried on the Class 1 railroads of the United States during the quarter ended June 30. This is shown by the statistical compilation just made public by the Interstate Commerce Commission. This compilation shows the tonnage of seventy commodities which were transported on the Class 1 roads—those having annual operating revenues above $1,000,000. These roads carry more than 90 per cent of all freight transported.

The tonnage of chemicals and explosives carried during the second quarter was somewhat greater than that during the first quarter, when it totaled 1,960,190 tons.

The fertilizer tonnage decreased decidedly during the second quarter. During that period 2,947,492 tons of fertilizer was handled by the principal railroads. During the first quarter the tonnage was 3,652,612.

The tonnage handled of some of the other commodities in which the chemical industry is interested is shown as follows in the report for the second quarter:

	Tons
Refined petroleum and its products	7,184,453
Vegetable oils	212,121
Sugar, sirup, glucose and molasses	1,485,118
Cotton seed and products, except oil	510,746
Crude petroleum	1,600,870
Pulp wood	1,396,486

Annual Meeting of the American Petroleum Institute

The convention of the American Petroleum Institute, which was held in Washington, Nov. 17 to 19, was significant principally because of the spirit of fraternity which was manifested. This was particularly striking to those acquainted with the antagonisms which have been assumed to exist between the independent operators and the representatives of the more highly organized companies. These interests now seem entirely disposed to work together to meet the common problems of their industry.

All of the officers and directors of the institute were reelected for the ensuing year. These officers are Thomas A. O'Donnell, president; S. Messer, vice-president; H. F. Sinclair, treasurer; R. L. Welsh, general secretary and counsel; C. C. Smith, assistant general secretary and treasurer.

Some of the important points brought out by the various speakers in their addresses were: That the demand for petroleum and its products is keeping pace with production and bears every promise of expanding in the future as rapidly as more crude can be supplied; the enormous demand for petroleum in America and the relatively smaller part our home production is going to play in the future necessitates going to foreign fields to supplement this demand; the necessity of foreign policy being changed so as to enable outside interests to help develop the oil resources for the good of all concerned instead of monopolizing the deposits for their own use; more freedom from governmental restrictions in the development of the oil industry by private individuals and corporations; the necessity of conservation of fuel oil as a means of power for our merchant marine and stimulation of further search for new sources of supply.

There was little of a chemical nature discussed. The group on Uniformity in Testing Methods, however, adopted the following resolutions:

> Resolved, That the Group Conference on "Uniformity in Testing Methods" recommend that the American Petroleum Institute call together and arrange to secure the co-operation and co-ordination of all existing agencies and petroleum associations working for or interested in uniformity in testing methods; to arrange for a central referee testing laboratory, the prompt dissemination of information concerning standard methods of tests and research work looking forward to improved methods of test.

Rennerfelt Electric Furnace Installed at the San Francisco Mint

In order to meet the increased demand for cents and nickels a $\frac{1}{2}$-ton Rennerfelt electric-arc furnace has been installed at the San Francisco Mint. The electric furnace replaces oil-fired crucible furnaces for the melting of stock for cents, the copper-nickel alloy used for five-cent pieces and also for the tin-zinc alloy which, with copper, forms the cent alloy. The furnace is of the three-phase type using $2\frac{1}{2}$-in. graphite electrodes, and is hand-operated. It is expected to produce a 1,000-lb. charge in three hours. A 1-ton and a 1,200-lb. Rennerfelt furnace have been operating at the Philadelphia Mint on the same alloys and have effected considerable saving in the cost of production.

It is only recently that the use of cents has become common in the West. The tax on theater tickets, 6c. and 7c. carfare and the cafeteria created the demand, and with a supply available the use of cents has become customary in stores.

Clayburn Co., Ltd., Reopens Kilgarde Plant

The Clayburn Co., Ltd., manufacturer of building brick, firebrick, tiles and drain pipes, has reopened its second plant at Kilgarde, B. C. Both of the plants at Kilgarde and those at Clayburn are now working at full capacity and more than 150 men are employed. The company is sending its products as far as Montreal in one direction and San Francisco in the other.

Canadian Electro Leather Industries Organized

The Canadian Electro Leather Industries has been organized in Vancouver, B. C., and will erect a plant at McKay Creek to treat 500 hides weekly. The cost of the plant will be between $30,000 and $40,000. Electricity is said to play an important part in the tanning process. A similar plant is said to be operating successfully at Singapore, and the McKay Creek plant is to be constructed on the same lines.

Carnegie Institute of Technology Has Elaborate Coal-Mining Laboratory

The Carnegie Institute of Technology of Pittsburgh is completing the most elaborate coal-mining laboratory in America. The laboratory, which will be finished by the opening of the fall term, is located beneath the building of the division of science and engineering of the institute. The equipment comprises a full-sized coal mine—a model mine, except that it yields no coal—a mine locomotive and a full set of coal and metal mine machinery, that has been furnished by manufacturers. In addition to the mining laboratories proper there will be a completely equipped ore-dressing and coal-washing plant. It is purposed to extend the mine during the practice work of the students along such a plan that it can be utilized for carrying some of the steam and water pipes of the institute.

Steel Co. to Be Established in British Columbia

Coast Range Steel, Ltd., has been incorporated, with a capitalization of $15,000,000, and head office at Vancouver, B. C. The provisional directors are H. J. Landahl, Fred T. Congdon, J. D. Kearns, John Steta and Montague Moore, all of Vancouver. The avowed object of the company is the establishment of an iron and steel plant in British Columbia. Arrangements have been made with the provincial government for a bounty of $3 per ton on all iron produced from British Columbia ore for a period of two years, with the probability of renewal, though possibly at a lower bounty. The concern is said to be backed by British capital, and there appears to be some evidence of this being so, as two British engineers, C. T. Williams and Francis Percy, have been in the province for the last two months investigating the iron-ore resources.

Paper Company of Dallas to Make Paper From Cotton Linters

The Trinity Paper Mills of Dallas, Tex., is to engage in the manufacture of pulp and paper from cotton linters, of which there is over 200,000 tons produced annually. There has been but small use for this product since the different governments suspended the immense production of nitro-cellulose in 1918. Large stores of this stock are accumulating while the cotton oil producers are forced to remove at least 75 lb. of lint per ton of seed in order to have a successful oil recovery, and the oil millers could profitably remove as much as 200 lb. per ton of seed, as the lint left on the seed absorbs oil. All of this 200 lb. of lint can be used profitably in paper making.

Briefly the treatment of cotton linters in making pulp suitable for high-grade paper is very similar to the treatment usually given rags. It is a soda process and the treatment of the stock offers no particular disadvantages over that of any other fiber now in use. It can be used successfully in the manufacture of several different grades of paper, such as book, writing, blotting, toweling, and in place of sulphite wood pulp in the manufacture of newsprint.

The company expects to have a pulp mill in operation at Commerce, Tex., in the near future.

Personal

FRANCIS L. ADAMS is now special inspector at the Jones & Laughlin Steel Co., South Side Works, Pittsburgh, Pa.

C. E. ALDEN is now with the Permutit Co., New York City, in its technical department.

Dr. GEORGE BORROWMAN, who recently returned from chemical investigations in Europe, has resigned from research work with Dr. J. E. Teeple, New York City, to enter independent practice in Chicago.

C. F. CARRIER, who has been taking a year's leave, has fully recovered his health and is now associated with the chemical department of J. Q. Dickinson & Co., Malden, W. Va.

EDWARD W. ENGELMANN, consulting research engineer of the Jackling porphyry properties, is in New York.

CLYDE L. FREAR has left the Merrell-Soule Co., where he had charge of the control laboratory, to accept a position with the U. S. Naval Experiment Station, Annapolis, Md.

JOHN M. HAYES, treasurer of the Utah Copper Co., Salt Lake City, has resigned and will remove to Los Angeles, Cal., at the end of the year.

J. H. MATTHEWS of Wisconsin University will address the Milwaukee Section of the American Chemical Society Dec. 3. His subject deals with photochemistry.

C. F. MILLSPAUGH, of the Field Columbian Museum, addressed the Chicago Chemists' Club on Tuesday, Nov. 23, on "Some Collections of Crude Materials and Their Relations to the Scientific Men of the West."

J. R. POWELL spoke before the Chicago Chemists' Club on Nov. 15 on colloidal clay, with special reference to the bentonite deposits in Wyoming.

Sir THOMAS KIRKE ROSE has been awarded the gold medal of the Institution of Mining and Metallurgy, the highest distinction in the power of the Council to bestow, "in recognition of his eminent service in the advancement of metallurgical science, with special reference to the metallurgy of gold."

FOREST RUTHERFORD, consulting metallurgist, New York City, has returned to New York after spending several months in Colorado on mine examinations and milling problems.

H. LIVINGSTON SULMAN has been awarded the Consolidated Gold Fields of South Africa, Ltd., gold medal and premium of forty guineas for his paper, "A Contribution to the Study of Flotation."

C. M. WELD, mining engineer, D. M. LIDDELL, chemical engineer and metallurgist, and P. H. LAZENBY, a civil engineer with wide experience in public utilities, have formed a partnership for practice as consulting engineers and economists under the firm name of Weld, Liddell & Lazenby, with offices at 2 Rector St., New York City.

JOHN ARTHUR WILSON, chairman of the Milwaukee Section, American Chemical Society, was in New York last week on business.

Current Market Reports

The Chemical and Allied Industrial Markets

New York, Nov. 29, 1920.

Tremendous resale pressure continued in evidence during the last week's activities and prices in several items suffered further recession. Inquiries, however, appear to be gaining more strength, but the differential is still wide enough between buyers and sellers to keep business quiet. Export orders were in evidence since the pronounced strengthening of foreign exchange. Consumers have adopted an ultra-conservative attitude even though producers are endeavoring to make prices attractive and real business is not passing.

In general the entire chemical movement was slow, with buyers content to operate only for actual wants. Sellers are still on the offensive so far as spot and near-by forwards are concerned, but the resistance is still relatively weak and the disposition seems to be to keep stocks as light as possible prior to the taking of inventory.

Solid caustic soda was offered in some directions at \$3.75 @\$4 per 100 lb., which is a new low record for this movement. Trading was not much in evidence and buyers are looking forward to further recessions. *Bleaching powder* broke down with keen competition and selling was reported as low as 3¾c. per lb. in small drums. Large drums at the works were quoted at 4c. per lb. *Bicarbonate of soda* producers report a steady movement against outstanding contracts to consuming trade and are quoting 2¾c. per lb. f.o.b. works. Factors in *chlorate of soda* are holding the market at 10c. per lb. works and are readily working off their output through standing contract channels. Spot supplies are not heavy, although odd lots could be obtained at a fraction under producers' figures. *Cream of tartar* has shown no evidence of life in the past few weeks and spot supplies are heard as low as 43c. per lb., with very little trading at this figure. Spot material of *oxalic acid* was heard on the market at 19c. per lb., with buyers showing relatively no interest. The range was up to 22c. per lb., depending on quantity, brand and seller. Improvement to the extent of inquiries was noted in *cyanide of soda* and indications gave promise of some better business developing. Supplies seem to be well scattered among dealers. German cyanide was held at 23@25c. per lb., French at 24@26c. and American at 29@30c. per lb.

Potash Salts

The potash industry has developed into one of the leading factors in the chemical market as American producers, confronted with a severe shortage and an incessant demand for potash products previously imported, set about to solve this difficult problem.

Like all other chemicals, potash has seen some abnormally high prices and producers have reaped a tremendous harvest in the last few years. Gunpowder manufacturers and foreign merchants were flooding the American market with a continuous volume of orders and prices soared far above the normal mark. In the past few months, however, with the general depression in business circles and recent German importations, potash has been on a sharp decline. Germany has once more come into the domestic market as a competitor, but the consensus of opinion in chemical circles is that it will be some years before any real imports can be expected to reach pre-war figures or before prices will be materially lowered to affect American producers. At present, however, America is looking forward to a fair supply from Europe, since it has not yet become able to meet the increased consuming demand. It is also certain that the new Administration will provide methods in the form of a new protective tariff to safeguard domestic producers from any strong foreign competition. In short, it seems probable that it will be many years before our European neighbors will be in a position to produce enough permanent surplus stock for the American market. In the meantime America will continue developing her own resources with the hope of becoming a self-sustaining industry.

The beginning of 1920 saw *bichromate of potash* the leading factor in the potash group. A shortage of chrome ore, transportation difficulties and strong foreign demand brought the price from 27c. per lb. in January to 42c. per lb. in May. During April leading producers announced a temporary discontinuance of production owing to inability to obtain raw materials. Speculators saw an opportunity to work the market and shot prices up from 30c. to 40c. per lb. Since June, however, a rapid decline has been noticed and material is now available at 21c. per lb. *Caustic potash* demand during the past year was accentuated in sympathy with all other leading chemicals. A wide demand was noted from soft-soap makers, who reported a large volume of orders on hand for all parts of Europe. Prices were on a sharp advance for this commodity during the first five months of the year, climbing from 25c. per lb. to 33c. per lb. Material can be obtained at present at 16c. per lb. The call for *chlorate of potash* from the match and fireworks trades kept the price very steady until the past few weeks. Large importations have weakened the spot market considerably, and even though dealers quote 15c. per lb., no real interest was shown by the consuming trade.

Coal-Tar Products

The coal-tar products market has taken the attitude of a secondary factor in the chemical industry. It seems that readjustments will have to be completed in all allied trades before anything can be satisfactorily undertaken in this branch. On the face of things it might seem that the proper thing to do would be to start at the crude end of the game and state plainly that any revisions downward are practically impossible or else make them at once and relieve further uncertainty. On the other hand, it is argued that nothing would be gained until the position of the ultimate consumer becomes better understood as to the extent of his probable needs. Reports show that large numbers of buyers are in town, but what purchasing is being done seems to be limited to small quantities to fill in for the holiday trade only, and until demand and prices become more stabilized in the allied lines, factors in the crude and intermediate markets contend that readjustment in prices would fail to stimulate buying. Trading during the week followed the regular routine that has prevailed during the past few weeks. Small quantities of *H acid* are reported moving at \$1.60 per lb. *Benzylchloride* producers report the general market requirements as rather light, while the supply is of usual fair volume with prices quoted at 25@35c. per lb. Supplies of *dinitrobenzene* retain their steady tendency with the output generally held by first hands, and show the usual range of prices from 32c. to 35c. per lb. Demand for *aniline salts* is light and available supplies are free enough to keep the market easy and dealers offer spot supplies at 32@33c. per lb. Sales of *aniline oil* are limited only to small quantities, and while producers are still quoting 30c. per lb. resale material is held at 27c. per lb., with very little business even at the outside figure.

Waxes

The wax market has been quiet and featureless for the last few weeks. Export orders, that have been so common in this commodity, have entirely disappeared of late and hand to mouth business to domestic consumers is about the only business noted.

Beeswax continued dull, with offerings fairly liberal, especially in the lower grades. *Crude African beeswax* was offered at 20c. per lb. and it was intimated that round lots for shipment might have brought concession. *Brazilian beeswax* was quoted nominally at 28@30c. per lb. The higher grades of *Carnauba wax* are holding up well considering the routine nature of business. Brazilian markets were unsettled according to advices received in local circles, causing dealers to hold aloof. *Carnauba No. 1* was held around the 85c. per lb. level. *No. 3 North Country* was unchanged and closed at 25@27c. per lb. Scattered business is noted in *Japan wax* for immediate delivery at 19@19½c. per lb., indicating that the market is fairly steady. The

export movement that has characterized the *paraffine wax* market has taken a great slump and dealers are inclined, therefore, to offer their merchandise at surprising concessions. *Crude 124-126 m.p.* was quoted at 7½c. per lb., with very little response from consumers.

POTASH SALTS

	Jan.—April	May—July	Aug.—Sept.	Oct.	Nov.
Bichromate Potash....	27-37c.	42-37c.	36-30c.	30-26c.	25-20c.
Caustic Potash 88-92 per cent.......	25-30c.	31-33c.	32-26c.	25-20c.	19-16c.
Muriate Potash, ton...	$150	$110	$125	$110	$100
Nitrate Potash........	13c.	13c.	14c.	13c.	11½c.
Permanganate Potash..	60-85c.	85-80c.	75-70c.	65c.	60c.
Prussiate Potash, yellow	35-37c.	35c.	36-38c.	38c.	34c.
Chlorate Potash.......	17-19c.	20c.	18c.	18c.	15c.

The Chicago Market

Chicago, Nov. 26, 1920.

Without exception, every line of trade in the chemical industry reports continued inactivity and further depression of prices. Most advisers to the trade recommend extreme caution in buying, and this advice is being followed to such an extent that no factors are making engagements for supplies in excess of thirty days' requirements. Undoubtedly those concerns which have been existing on week-to-week supplies of chemicals will, when they figure the bottom has been reached, come into the market with some real buying.

Coal-tar products seem to occupy the weakest position as the result of heavy imports. Total importations of coal-tar products for the first nine months of this year is $7,865,000, against $4,740,000 for the same portion of last year. The Department of Commerce reports imports of chemicals, drugs, dyes, etc., for the period from Jan. 1 to Oct. 1, 1920, of $165,527,000, compared with $84,846,000 in 1919.

Heavy Chemicals

Plentiful supplies of all commodities are in evidence, but buyers are content to look on. Price recessions seem to excite no interest, and it is doubtful if even radical and unjustifiable cuts would induce any heavy buying, as all chemical users seem committed to a policy of day-to-day buying. *Bleaching powder* of various grades and at various prices is offered in plenty. Quotations on spots cover a wide range, figures from $3.85 to $5.25 per 100 lb. being heard. *Soda ash* also is getting no rapid action even when offered at below 2c. per lb. It can be purchased as low as 1.90c. Spot *caustic soda* is offered from warehouse at $4. Some sales are mentioned at as low as $3.90. *Sal soda*, quoted about $2 per 100 lb., is also weak.

Soda nitrite, under pressure of plentiful supply, is offered at $7.35, but not much business is being done at any figure. Holders of stock show every disposition to shade prices. *Soda cyanide*, affected by importations, is freely offered at 22@23c. per lb. *Nickel salts*, with a dull market catching heavy supplies in second hands, is offered on the spot at 14c. for the single salts. Manufacturers' price is about 2c. higher on the pound.

Trade in *alcohol* is very quiet, producers being reported as holding large stocks of all grades. The only price change of moment has been in *denatured*, which is now offered at 82@85c. per gal. for 96 per cent. *Glycerine* quotations of 20c. per lb. for c.p. grade, drums extra, are ruling, with but light buying resulting. Dynamite grade is 17½c. or 19c., depending on whether you are a buyer or a seller.

Acids are equally dull, with only small transactions noted; 60 per cent pure *acetic* is offered at $10 per 100 lb., *nitric* at $8.25 per 100 lb. for 42 deg., *sulphuric* at $21 per ton for 66 deg. and *pyrogallic* at $1.92 in crystal form.

Coal-Tar Products

Overstocked domestic markets, combined with heavy imports, are forcing price levels down, in spite of which but little interest is shown by buyers. *Phenol* has taken a slump to 10¼c. per lb. for spot offerings and it appears that real money would shade this from ¼c. to ½c. *Naphthalene* has suffered from large offerings of German goods and either balls or flakes can be had for 10c. per lb. or less. *Toluene* is weak and uncertain, quotations ranging in the neighborhood of 32c. per gal. *Benzene* alone is remaining fairly firm at 37c. per gal. for the pure. Demand on this item is well maintained.

Intermediates in the hands of makers are firmly held, but second hands are plainly worried at the stagnant market and are eager to shade prices. *Aniline oil*, offered at 25c. per lb., faces few takers, and the *salts*, at 33c. are even in less demand. *Benzaldehyde* is down to 55c. per lb. for technical grade and *beta naphthol* is offered at 40c. or even less. *Phosgene* is in good supply and fair demand at 45c. per lb.

Vegetable Oils

The downward trend of the market is proceeding without interruption, and temperatures above the average for the season are helping it along. *Linseed oil* is offered in tanks at 80c. and in small lots from jobbers' stocks at $1 per gal. Prime summer yellow *cottonseed oil* is quoted at 8c. per lb. in sellers' tanks. *Corn oil*, at 8½c. per lb. in tanks f.o.b. Chicago, excites no interest, and but little business is being done in *coconut oil* at 16c. per lb. in barrels out of stock. *Red oil*, in tanks, is quoted locally at about 9½c. per lb.

Naval Stores

Conservative buying is the rule locally, both buyers and sellers apparently feeling their way with caution. Reports of reduced activity in the various consuming industries offset to a certain extent the effect of the reported smaller available supply. Withdrawal of foreign buyers from Eastern markets has effected price reductions, but a study of conditions shows that a reaction would not be a surprise. Producers show no great desire to get rid of stocks. Local quotation on *turpentine* is $1.29 per gal. in barrels, $1.22 per gal. in tanks. *Rosin* is held at $11.50@$11.65 for all grades.

The St. Louis Market

St. Louis, Mo., Nov. 26, 1920.

A further slowing up of spot business is the only change to be noted in this market during the past two weeks. In this way the depression in other lines is making itself felt in heavy chemical demand, but producers state that their shipments on contract are practically normal and that they are renewing contracts satisfactorily. Evidently fears of the necessity of cutting production have been allayed as one of the largest heavy chemical producers is planning an increase in output. The prices which were established around the beginning of November are holding firmly and producers feel that they have them under their control and are able to keep them on a sound basis. The decline in spot business seems to indicate that buyers are staying as close as possible to their day-to-day needs and producers do not look for this situation to be relieved until the depression in other lines ends.

The demand for 66 deg. *sulphuric acid* remains slow but fairly steady and prices are being maintained at $22 per ton, carload lots. Oil refinery demand is at a satisfactory level and little decline in the demand from this quarter is expected. Quietness also marks the 98 per cent sulphuric acid market. It is quoted at $25 per ton f.o.b. works. The quotation on the 60 deg. sulphuric acid is $16.50 per ton and 1½c. per lb. in carboys, with demand slow. *Oleum* is holding at $28.50 per ton.

Demand for *muriatic acid* is dull, but producers have not very large supplies on hand and have the situation well in hand. The price is holding at 1¾@2c. per lb. in carboys and $25 per ton in bulk.

The demand for *sodium bisulphate* (niter cake) is steady and the advanced quotations noted two weeks ago are still holding. The quotations are $7@$8 per ton.

The *nitric acid* market is slightly more active and prices of two weeks ago hold good. Quotations are $7 per 100 lb. for the 36 deg. test and $10 per 100 lb. for the 42 deg. test. Standard mixed acid is quoted at 1½c. per lb. of sulphuric content and 11½c. per lb. of nitric acid. Inquiries show no decrease but orders have fallen off slightly.

No further advance has been noted on *zinc chloride*, for which demand is fairly strong. It is quoted at $4.50 per 100 lb. There has been no change in the market for U. S Government supplies of *phenol*.

The Iron and Steel Market

Pittsburgh, Pa., Nov. 26, 1920.

Steel production by the independents continues to decrease rapidly, while the Steel Corporation maintains its production rate, the divergence being due of course to the difference in order books, as to volume of business and price involved. Some estimates place the rate of independent mill operation at an average of less than 50 per cent of capacity, and many mills are operating much below that as regards ingots.

Chairman Gary of the United States Steel Corporation late last week issued another of the periodical statements that the corporation has no intention at this time of changing its prices. The Industrial Board prices were promulgated March 21, 1919, and at intervals since then expectations have arisen that the corporation would advance above that schedule, making it desirable for Judge Gary to issue a statement indicating that the expectations were unfounded. The latest statement, however, may be viewed also as a statement that the corporation will not reduce its prices.

Probably as a result of Judge Gary's statement the independent steel producers generally began today to quote the Steel Corporation prices on bars, shapes and plates, these prices being 2.35c. on bars, 2.45c. on shapes and 2.65c. on plates. On Wednesday a canvass of at least half a dozen large independents showed that they were quoting bars, shapes and plates all at 3c., so that the reductions today on the part of these independents are $13 per net ton on bars, $11 on shapes and $7 on plates. Several independents, however, have for several weeks past been quoting prices at or near the Steel Corporation level on particularly attractive inquiries.

As to rails, however, the interpretation of the Steel Corporation statement is clear in the minds of the trade, that there had been no thought of a reduction, but instead some thought of an advance. The Industrial Board prices were $45 per gross ton for bessemer and $47 for open-hearth rails, and of late some independents have quoted as much as $16 over these prices. The Steel Corporation had made large reservations for 1921, prices to be named not later than Jan. 1. It is related that the railroads fully expected to pay the corporation at least $50 for open-hearth rails.

Steel Prices

In sheets the market continues to decline. Blue annealed sheets have been offered in all gages on the basis of 4.50c. for 10 gage, or $19 a ton above the Steel Corporation price. Black sheets have been offered down to 5.50c., or $13 a ton above the corporation price. Galvanized sheets are offered by one mill at 6.70c., or $20 over the corporation price, although that independent may be alone in quoting under 7c.

The first sale of any semi-finished steel by an independent at the Steel Corporation price has just occurred, 6,000 tons for December, January and February being sold at $48.40 delivered to a mill which has a freight rate of $1.40 from Pittsburgh, this being equivalent to the Steel Corporation price of $47 Pittsburgh. The trade has not ascertained who made the sale. Quotations on the inquiry ran up to $60, one mill quoting $60 Youngstown, equal to $62.10 delivered, and another $60 Pittsburgh, or $61.40 delivered. As to sheet bars, however, it is predicted in some quarters that the Steel Corporation will recede to the Industrial Board price of $42, its advance in September to $47 having applied merely to certain contracts that involve a quarterly fixing of price.

Pig Iron

Bessemer and basic pig iron have receded $2.50 in the week, being now available at $37.50 valley for bessemer and at $35 valley for basic. There was little temptation by way of inquiry to induce the declines. The basic decline appears to have been prompted chiefly by the offering of iron by steel works that normally consume their entire product themselves. Foundry iron remains nominally quotable at $39 valley. The recession from the top prices reached late last August, while perfectly natural in a way, has been phenomenally rapid. The total recessions to date are $11 in bessemer, $13.50 in basic and $11 in foundry. There is no doubt that iron will go below $30, but the rest of the decline may be slower.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	......–......	$0.65 – $0.75
Acetone	lb.	$0.15¾–$0.16¼	.16¼– .17
Acid, acetic, 28 per cent	100 lbs.	3.00 – 3.25	3.50 – 3.75
Acetic, 56 per cent	100 lbs.	7.25 – 7.50	7.75 – 8.00
Acetic, glacial, 99½ per cent, carboys	100 lbs.	11.50 –12.00	12.50 –......
Boric, crystals	lb.	.15½– .16	.16½– .17½
Boric, powder	lb.	.15½– .16½	.17 – .20
Citric	lb.	......–......	.52 – .54
Hydrochloric (nominal)	100 lb.	1.85 – 2.25	2.75 – 3.00
Hydrofluoric, 52 per cent (nominal)	lb.	.15 – .16	.16½– .18
Lactic, 44 per cent tech	lb.	.10 – .11	.11½– .12
Lactic, 22 per cent tech	lb.	.04½– .05½	.06 – .07
Molybdic, C. P.	lb.	4.00 – 4.50	4.50 – 5.00
Muriatic, 20 deg. (see hydrochloric)		......–......	......–......
Nitric, 40 deg	lb.	.07 – .07½	.08 – .08¾
Nitric, 42 deg	lb.	.07½– .08	.08½– .09½
Oxalic, crystals	lb.	.20 – .20½	.21 – .21½
Phosphoric, Ortho, 50 per cent solution	lb.	.19 – .19½	.19¾– .21
Picric	lb.	.28 – .35	.40 – .50
Pyrogallic, resublimed	lb.	2.30 – 2.55	2.60 – 2.65
Sulphuric, 60 deg., tank cars	ton	......–......	......–......
Sulphuric, 60 deg., drums	ton	......–......	11.00 – 12.00
Sulphuric, 66 deg., tank cars	ton	18.00 –19.00	......–......
Sulphuric, 66 deg., drums	ton	21.00 –22.00	22.50 – 23.00
Sulphuric, 66 deg., carboys	ton	......–......	......–......
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	27.00 –30.00	37.00 – 42.00
Sulphuric, fuming, 20 per cent (oleum) drums	ton	28.00 –30.00	38.00 – 42.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	32.00–35.00	40.00 –......
Tannic, U. S. P.	lb.	......–......	1.35 – 1.45
Tannic (tech.)	lb.	.50 – .55	.56 – .60
Tartaric, crystals	lb.	......–......	.49 – .52
Tungstic, per lb. of WO	lb.	......–......	1.20 – 1.40
Alcohol, Ethyl (nominal)	gal.	..... –	5.50 – 5.75
Alcohol, Methyl (see methanol)		......–......	......–......
Alcohol, denatured, 188 proof (nominal)	gal.	......–......	.82 – .85
Alcohol, denatured, 190 proof (nominal)	gal.	......–......	.88 – .90
Alum, ammonia lump	lb.	.04½– .04¾	.05 – .05½
Alum, potash lump	lb.	.05½– .06	.06½– .07
Alum, chrome lump	lb.	.14½– .15	.16 – .17
Aluminum sulphate, commercial	lb.	.02¾– .03	.03¼– .03½
Aluminum sulphate, iron free	lb.	.03¾– .04	.04¼– .04½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.08¾– .09¾	.09½– .10½
Ammonia, anhydrous, cylinders (100-150 lb.)	lb.	.33 – .35	.36 – .38
Ammonium carbonate, powder	lb.	.14 – .14¾	.14½– .15
Ammonium chloride, granular (white salammoniac) (nominal)	lb.	.12½– .13	.13¼– .13½
Ammonium chloride, granular (gray salammoniac)	lb.	.11 – .12	.12½– .13
Ammonium nitrate	lb.	......– .10	.11 – .14
Ammonium sulphate	lb.	.04¼– .04½	.04¾– .05
Amylacetate	gal.	......–......	4.50 – 5.00
Amylacetate tech	gal.	......–......	4.00 – 4.20
Arsenic, oxide, lumps (white arsenic)	lb.	.12½– .13	.13¼– .13½
Arsenic, sulphide, powdered (red arsenic)	lb.	.16 – .16½	.16¾– .17½
Barium chloride	ton	90.00 –95.00	100.00 –105.00
Barium dioxide (peroxide)	lb.	.24 – .25	.26 – .27
Barium nitrate	lb.	.12 – .12½	.13 – .13½
Barium sulphate (precip.) (blanc fixe)	lb.	.04½– .05	.05½– .06
Bleaching powder (see calcium hypochlorite)		......–......	......–......
Blue vitriol (see copper sulphate)		......–......	......–......
Borax (see sodium borate)		......–......	......–......
Brimstone (see sulphur, roll)		......–......	......–......
Bromine	lb.	.70 – .80	.85 – .90
Calcium acetate	100 lbs.	3.50 – 3.55	......–......
Calcium carbide	lb.	.04½– .05	.05¼– .05½
Calcium chloride, fused, lump	ton	30.00 –32.00	33.00 – 35.00
Calcium chloride, granulated	lb.	.02 – .02½	.03 – .03½
Calcium hypochlorite (bleaching powder)	lb.	.03¾– .04	.04½– .05
Calcium peroxide	lb.	......–......	1.50 – 1.70
Calcium phosphate, monobasic	lb.	......–......	.75 – .80
Calcium sulphate, pure	lb.	......–......	.25 – .30
Camphor	lb.	......–......	1.05 – 1.10
Carbon bisulphide	lb.	.08 – .09	.10 – .11
Carbon tetrachloride, drums	lb.	.13 – .13½	.14 – .14½
Carbonyl chloride (phosgene)	lb.	......–......	.60 – .75
Caustic potash (see potassium hydroxide)		......–......	......–......
Caustic soda (see sodium hydroxide)		......–......	......–......
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.09 – .09½	.10 – .10½
Chloroform	lb.	......–......	.43 – .50
Cobalt oxide	lb.	......–......	3.90 – 4.00
Copperas (see iron sulphate)		......–......	......–......
Copper carbonate, green precipitate	lb.	.23 – .24	.24½– .25½
Copper cyanide	lb.	......–......	.65 – .70
Copper sulphate, crystals	lb.	.07 – .07½	.07¾– .08½
Cream of tartar (see potassium bitartrate)		......–......	......–......
Epsom salt (see magnesium sulphate)		......–......	......–......
Ethyl Acetate Com. 85%	gal.	......–......	1.05 – 1.10
Ethy Acetate pure (acetic ether 98% to 100%)		......–......	......–......
Formaldehyde, 40 per cent (nominal)	lb.	.18 – .18½	.19 – .20
Fusel oil, ref	gal.	......–......	3.60 – 3.75
Fusel oil, crude (nominal)	gal.	......–......	3.25 – 3.50
Glauber's salt (see sodium sulphate)		......–......	......–......
Glycerine, C. P. drums extra	lb.	......–......	.21 – .22
Iodine, resublimed	lb.	......–......	3.75 – 4.00
Iron oxide, red	lb.	......–......	.15 – .25
Iron sulphate (copperas)	100 lbs.	2.25 – 2.50	2.75 – 3.00
Lead acetate, normal	lb.	......–......	.13½– .16
Lead arsenate (paste)	lb.	.13 – .14	.14½– .15
Lead nitrate, crystals	lb.	......–......	.90 – 1.00
Litharge	lb.	.12 – .12¾	.13 – .13½
Lithium carbonate	lb.	......–......	1.50 –......
Magnesium carbonate, technical	lb.	.10½– .11	.11½– .12
Magnesium sulphate, U. S. P.	100 lb.	3.50 – 4.00	......–......
Magnesium sulphate, commercial	100 lb.	......–......	3.00 – 3.25
Methanol, 95%	gal.	......–......	1.85 – 1.90
Methanol, pure	gal.	......–......	2.30 – 2.35
Nickel salt, double	lb.	......–......	.12 – .12½
Nickel salt, single	lb.	......–......	.13 – .13½
Phosgene (see carbonyl chloride)		......–......	......–......
Phosphorus, red	lb.	.50 – .52	.53 – .55
Phosphorus, yellow	lb.	......–......	.35 – .37
Potassium bichromate	lb.	.20 – .21	.21½– .22½

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$0.45 – $0.47	$0.48 – $0.49
Potassium bromide, granular	lb.	...... –	.45 – .50
Potassium carbonate, U. S. P.	lb.	.50 – .55	.56 – .60
Potassium carbonate, crude	lb.	.13 – .13½	.13¾– .14
Potassium chlorate, crystals	lb.	.14 – .14½	.15 – .15½
Potassium hydroxide (caustic potash)	lb.	.16 – .16½	.16¾– .17
Potassium iodide	lb.	...... –	3.00 – 3.20
Potassium nitrate	lb.	.14 – .16	.16½– .17
Potassium permanganate	lb.	.60 – .63	.65 – .70
Potassium prussiate, red	lb.	.55 – .57	.58 – .60
Potassium prussiate, yellow	lb.	.34 – .35	.35½– .36
Potassium sulphate (powdered)	ton	$240.00 – 255.00	...... – ......
Rochelle salts (see sodium potas. tartrate)		...... –	...... – ......
Salammoniac (see ammonium chloride)		...... –	...... – ......
Sal soda (see sodium carbonate)		...... –	....
Salt cake	ton	...... –	52.00 – 55.00
Silver cyanide (nominal)	oz.	...... –	1.25 – ......
Silver nitrate (nominal)	oz.	...... –	.55 – .57
Soda ash, light	100 lb.	1.90 – 2.00	2.10 – 2.30
Soda ash, dense	100 lb.	2.50 – 2.75	3.00 – 3.25
Sodium acetate	lb.	.08 – .08½	.08¾– .09
Sodium bicarbonate	100 lb.	2.90 – 3.00	3.25 – 3.50
Sodium bichromate	lb.	.09 – .09½	.09¾– .10
Sodium bisulphate (nitre cake)	ton	7.00 – 7.50	8.00 – 11.00
Sodium bisulphite powdered, U.S.P.	lb.	.06½– .07	.07½– .08
Sodium borate (borax)	lb.	.08½– .08¾	.09 – .09½
Sodium carbonate (sal soda)	100 lb.	1.85 – 2.00	2.15 – 2.25
Sodium chlorate	lb.	.10 – .10½	.10¾– .11
Sodium cyanide, 96-98 per cent	lb.	.24 – .25	.26 – .28
Sodium fluoride	lb.	.17 – .17½	.17¾– .18½
Sodium hydroxide (caustic soda)	100 lb.	4.00 – 4.10	4.30 – 4.50
Sodium hyposulphite	lb.	...... –	.04 .04½
Sodium molybdate	lb.	2.50 –	3.25 – ......
Sodium nitrate	100 lb.	3.00 –	3.25 – ......
Sodium nitrite	lb.	.07¼– .07½	.07¾– .08
Sodium peroxide, powdered	lb.	.35 – .40	.42 – .45
Sodium phosphate, dibasic	lb.	.03¾– .04¼	.04½– .05
Sodium potassium tartrate (Rochelle salts)	lb.	...... –	.33 – .35
Sodium prussiate, yellow	lb.	.18 – .18½	.19 – .20
Sodium silicate, solution (40 deg.)	lb.	.01¼– .01½	.02 – .02½
Sodium silicate, solution (60 deg.)	lb.	.03 – .03½	.03½– .04
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	2.15 – 2.50	2.60 – 2.75
Sodium sulphide, crystal, 60-62 per cent (conc)	lb.	.07 – .07½	.07½– .08
Sodium sulphite, crystals	lb.	.04 – .04½	.04½– .05
Strontium nitrate, powdered	lb.	.20 – .20½	.21 – .22
Sulphur chloride red	lb.	.08 – .09	.10 – .10½
Sulphur, crude	ton	16.00 – 20.00	...... – ......
Sulphur dioxide, liquid, cylinders	lb.	.09 –	.10 – .12
Sulphur (sublimed), flour	100 lb.	...... –	3.70 – 4.35
Sulphur, roll (brimstone)	100 lb.	...... –	3.40 – 3.90
Tin bichloride, 50 per cent	lb.	.18 – .19	...... – ......
Tin oxide	lb.	...... –	.50 – .51
Zinc carbonate, precipitate	lb.	.16 – .18	.19 – .20
Zinc chloride, gran.	lb.	.12 – .13	.13½– .14
Zinc cyanide	lb.	.45 – .49	.50 – .60
Zinc dust	lb.	.12 – .13	.13 – .14
Zinc oxide, XX	lb.	.10 – .10½	.11 – .11½
Zinc sulphate	lb.	.03½– .03¾	.04 – .06

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.10	— $1.15
Alpha-naphthol, refined	lb.	1.45	— 1.50
Alpha-naphthylamine	lb.	.44	— .46
Aniline oil, drums extra	lb.	.26	— .27
Aniline salts	lb.	.32	— .33
Anthracene, 80% in drums (100 lb.)	lb.	.90	— 1.00
Benzaldehyde (f.f.c.)	lb.	2.00	— 2.10
Benzidine, base	lb.	1.15	— 1.20
Benzidine sulphate	lb.	1.10	— 1.15
Benzoic acid, U.S.P.	lb.	.80	— .85
Benzoate of soda, U.S.P.	lb.	.80	— .90
Benzene, pure, water-white, in drums (100 gal)	gal.	.35	— .40
Benzene, 90%, in drums (100 gal)	gal.	.32	— .35
Benzyl chloride, 95-97%, refined	lb.	.35	— .40
Benzyl chloride, tech.	lb.	.25	— .35
Beta-naphthol benzoate (nominal)	lb.	3.50	— 4.00
Beta-naphthol, sublimed (nominal)	lb.	.75	— .80
Beta-naphthol, tech (nominal)	lb.	.40	— .45
Beta-naphthylamine, sublimed	lb.	2.25	— 2.40
Cresol, U. S. P., in drums (100 lb.)	lb.	.18	— .19
Ortho-cresol, in drums (100 lb.)	lb.	.23	— .25
Cresylic acid, 97-99%, straw color, in drums	gal.	1.10	— 1.15
Cresylic acid, 95-97%, dark, in drums	gal.	1.05	— 1.10
Cresylic acid, 50%, first quality, drums	gal.	.65	— .75
Dichlorbenzene	lb.	.07	— .10
Diethylaniline	lb.	1.45	— 1.50
Dimethylaniline	lb.	.75	— .80
Dinitrobenzene	lb.	.30	— .37
Dinitroclorbenzene	lb.	.27	— .32
Dinitronaphthalene	lb.	.42	— .45
Dinitrophenol	lb.	.40	— .45
Dinitrotoluene	lb.	.30	— .32
Dip oil, 25%, tar acids, car lots, in drums	gal.	.38	— .40
Diphenylamine (nominal)	lb.	.75	— .77
H-acid (nominal)	lb.	1.60	— 1.65
Meta-phenylenediamine	lb.	1.25	— 1.30
Monochlorbenzene	lb.	.17	— .18
Monoethylaniline	lb.	1.75	— 2.25
Naphthalene crushed, in bbls. (250 lb.)	lb.	.09	— .09½
Naphthalene, flake	lb.	.09	— .09½
Naphthalene, balls	lb.	.09½	— .10
Naphthionic acid, crude	lb.	.70	— .75
Nitrobenzene	lb.	.12	— .15
Nitro-naphthalene	lb.	.40	— .50
Nitro-toluene	lb.	.18	— .25
Ortho-amidophenol	lb.	3.20	— 3.75
Ortho-dichlor-benzene	lb.	.15	— .20
Ortho-nitro-phenol	lb.	.75	— .80
Ortho-nitro-toluene	lb.	.25	— .40
Ortho-toluidine	lb.	.30	— .32
Para-amidophenol, base	lb.	2.35	— 2.40
Para-amidophenol, HCl	lb.	2.25	— 2.30
Para-dichlorbenzene	lb.	.10	— .15
Paranitroaniline	lb.	1.10	— 1.15
Para-nitrotoluene	lb.	1.25	— 1.40
Para-phenylenediamine	lb.	2.20	— 2.35
Para-toluidine	lb.	1.85	— 2.00
Phthalic anhydride	lb.	.60	— .70
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.08	— .10
Pyridine	gal.	2.00	— 3.50
Resorcinol, technical	lb.	2.90	— 3.00
Resorcinol, pure	lb.	3.75	— 4.15
Salicylic acid, tech., in bbls. (110 lb.)	lb.	.35	— .38
Salicylic acid, U. S. P.	lb.	.40	— .45
Salol	lb.	.85	— .95
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.30	— .35
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.19	— .22
Sulphanilic acid, crude	lb.	.32	— .35
Tolidine	lb.	1.45	— 1.50
Toluidine, mixed	lb.	.45	— .55
Toluene, in tank cars	gal.	.35	— .....
Toluene, in drums	gal.	.38	— .40
Xylidines, drums, 100 gal.	lb.	.45	— .50
Xylene, pure, in drums	gal.	.45	— .47
Xylene, pure, in tank cars	gal.	.45	— .....
Xylene, commercial, in drums, 100 gal.	gal.	.37	— .38
Xylene, commercial, in tank cars	gal.	.30	— .....

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.26	— $0.27
Beeswax, refined, light	lb.	.28	— .30
Beeswax, white pure	lb.	.35	— .40
Carnauba, No. 1. (nominal)	lb.	.80	— .90
Carnauba, No. 2, regular (nominal)	lb.	.70	— .80
Carnauba, No. 3, North Country	lb.	.25	— .26
Japan	lb.	.19	— .20
Montan, crude	lb.	.12	— .14
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.07½	— .08
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.07½	— .07¾
Paraffine waxes, refined, 118-120 m.p.	lb.	.09	— .09¼
Paraffine waxes, refined, 125 m.p.	lb.	.09¼	— .09½
Paraffine waxes, refined, 128-130 m.p.	lb.	.10½	— .11
Paraffine waxes, refined, 133-135 m.p.	lb.	.13½	— .14½
Paraffine waxes, refined, 135-137 m.p.	lb.	.14½	— .15½
Stearic acid, single pressed	lb.	.17½	— .17¾
Stearic acid, double pressed	lb.	.18½	— .19
Stearic acid, triple pressed	lb.	.22½	— .23

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr., 0.930-0.940	gal.	$1.90
Pine oil, pure, dest. dist.	gal.	1.50
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	.48
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.	.75
Pine tar, ref., thin, sp. gr., 1.080-1.960	gal.	.36
Turpentine, crude, sp. gr., 0.900-0.970	gal.	1.25
Hardwood oil, f.o.b. Mich., sp. gr., 0.960-0.990	gal.	.35
Pinewood creosote, ref.	gal.	.52

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.	280 lb.	$11.25	— .....
Rosin E-I	280 lb.	11.25	— .....
Rosin K-N	280 lb.	11.25	— .....
Rosin W. G.-W. W.	280 lb.	11.50	— 11.75
Wood rosin, bbl.	280 lb.	11.00	— .....
Spirits of turpentine	gal.	1.02	— .....
Wood turpentine, steam dist.	gal.	1.00	— .....
Wood turpentine, dest. dist.	gal.	1.00	— .....
Pine tar pitch, bbl.	200 lb.	.....	— 8.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	— 15.00
Retort tar, bbl.	500 lb.	15.00	— 15.50
Rosin oil, first run	gal.	.70	— .....
Rosin oil, second run	gal.	.73	— .....
Rosin oil, third run	gal.	.90	— .....

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.41
70-72 deg., steel bbls. (85 lb.)	gal.	.39
68-70 deg., steel bbls. (85 lb.)	gal.	.38
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.30

Crude Rubber

Para—Upriver fine (nominal)	lb.	$0.22	—$0.23
Upriver coarse (nominal)	lb.	.15	— .16
Upriver caucho ball (nominal)	lb.	.16½	— .17½
Plantation—First latex crepe	lb.	.19	— .....
Ribbed smoked sheets	lb.	.18	— .....
Brown crepe, thin, clean	lb.	.16	— .....
Amber crepe No. 1	lb.	.17	— .....

Oils

VEGETABLE

The following prices are f.o.b., New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.14½	— $0.15
Castor oil, AA, in bbls.	lb.	.15¾	— .16½
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.12½	— .12½
Cocoanut oil, Ceylon grade, in bbls.	lb.	.14	— .14½
Cocoanut oil, Cochin grade, in bbls (nominal)	lb.	.15¾	— .16½
Corn oil, crude, in bbls.	lb.	.10	— .10½
Cottonseed oil, crude (f.o.b. mill)	lb.	.06	— .07
Cottonseed oil, summer yellow	lb.	.09½	— .10
Cottonseed oil, winter yellow	lb.	.11	— .12
Linseed oil, raw, car lots (domestic)	gal.	.83	— ....
Linseed oil, raw, tank cars (domestic)	gal.	.80	— ....
Linseed oil, boiled, car lots (domestic)	gal.	.85	— ....

Olive oil, commercial	gal.	2.75	—	3.00
Palm, Lagos	lb.	.09½	—	.09¾
Palm, Niger	lb.	.09	—	.09¼
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¾	—	.09
Peanut oil, refined, in bbls	lb.	.15	—	.15½
Rapeseed oil, refined in bbls	gal.	1.15	—	1.20
Rapeseed oil, blown, in bbls	gal.	1.25	—	1.35
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.09½	—	.10
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.07	—	.07½

FISH

Light pressed Menhaden	gal.	$0.65	—	$0.70
Yellow bleached Menhaden	gal.	.67	—	.70
White bleached Menhaden	gal.	.72	—	.75
Blown Menhaden	gal.	1.05	—	1.10

Miscellaneous Materials

All f. o. b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00	—	$30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00	—	26.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	10.00	—	12.00
Barytes, floated, f.o.b. St. Louis	net ton	26.50	—	28.00
Barytes, crude, first grade, Missouri	net ton	10.00	—	.....
Blanc fixe, dry	lb.	.05	—	.05½
Blanc fixe, pulp	net ton	60.00	—	65.00
Caseine	lb.	.14	—	.18
Chalk, domestic, extra light	lb.	.05	—	.06
Chalk, domestic, light	lb.	.04½	—	.05½
Chalk, domestic, heavy	lb.	.04	—	.05
Chalk, English, extra light	lb.	.05	—	.07
Chalk, English, light	lb.	.05	—	.06
Chalk, English, dense	lb.	.04½	—	.05
China clay, (Kaolin) crude, f.o.b. mines, Georgia	net ton	8.00	—	10.00
China clay (Kaolin) washed, f.o.b. Georgia	net ton	12.00	—	15.00
China clay (Kaolin) powdered, f.o.b. Georgia	net ton	18.00	—	22.00
China clay (Kaolin) crude f.o.b. Virginia points	net ton	8.00	—	12.00
China clay (Kaolin) ground, f.o.b. Virginia points	net ton	15.00	—	40.00
China clay (Kaolin), imported, lump	net ton	25.00	—	35.00
China clay (Kaolin), imported, powdered	net ton	30.00	—	35.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	8.00	—	14.00
Feldspar, crude, f.o.b. Maine	net ton	7.50	—	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00	—	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00	—	30.00
Fuller's Earth, f.o.b. New York	net ton	......	—	18.00
Fuller's earth, granular, f.o.b. Fla.	net ton	25.00	—	.....
Fuller's earth, powdered, f.o.b. Fla.	net ton	18.00	—	.....
Fuller's earth, imported, powdered	net ton	35.00	—	40.00
Graphite, crucible, 90% carbon, Ashland, Ala.	lb.	......	—	.09
Graphite, crucible, 85% carbon, Ashland, Ala.	lb.	.07	—	.09
Graphite, higher lubricating grades	lb.	.11	—	.40
Pumice stone, imported, lump	lb.	.04	—	.50
Pumice stone, domestic, lump	lb.	.06	—	....
Pumice stone, ground	lb.	.04	—	.07
Quartz (acid tower) fist to head, f.o.b. Baltimore	net ton	......	—	10.00
Quartz (acid tower) 1¼@2 in., f.o.b. Baltimore	net ton	......	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	......	—	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00	—	7.50
Shellac, orange fine	lb.	1.00	—	1.05
Shellac, orange superfine	lb.	1.05	—	1.10
Shellac, A. C. garnet	lb.	.90	—	.95
Shellac, T. N.	lb.	.85	—	.95
Soapstone	ton	15.00	—	25.00
Sodium Chloride	long ton	......	—	17.50
Talc, paper-making grades, f.o.b. Vermont	ton	12.00	—	22.00
Talc, roofing grades, f.o.b. Vermont	ton	9.50	—	15.00
Talc, rubber grades, f.o.b. Vermont	ton	12.00	—	18.00
Talc, powdered, Southern, f.o.b. cars	ton	12.00	—	15.00
Talc, imported	ton	60.00	—	70.00
Talc, California Talcum Powder grade	ton	20.00	—	45.00

Refractories

Bauxite brick, 56% Al., f.o.b. Pittsburgh	1,000	160
Chrome brick, f.o.b. Eastern shipping points	net ton	100-110
Chrome cement, 40-45% Cr_2O_3	net ton	55-60
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	60-65
Fire clay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	55-60
Fire clay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	45-50
Magnesite brick, 9-in. straight	net ton	110
Magnesite brick, 9-in. arches, wedges and keys	net ton	121
Magnesite brick, soaps and splits	net ton	134
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	65-70
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	56-61
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	55-60

Ferro-Alloys

All f.o.b. Works

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00	—	$225.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon, carlots	lb.	.17	—	.18
Ferro-chrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.16	—	.17
Ferro-manganese, 76-80% Mn, domestic	gross ton	155.00	—	160.00
Ferro-manganese, 76-80% Mn, English	gross ton	150.00	—	155.00
Spiegeleisen, 18-22% Mn	gross ton	60.00	—	70.00
Ferro-molybdenum, 50-60% Mo, per lb. of Mo.	lb.	2.00	—	2.50
Ferro-silicon, 10-15%	gross ton	60.00	—	65.00
Ferro-silicon, 50%	gross ton	80.00	—	85.00
Ferro-silicon, 75%	gross ton	......	—	160.00
Ferro-tungsten, 70-80%, per lb. of contained W	lb.	.75	—	.90
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	7.00	—	.....
Ferro-vanadium, 30-40% per lb. of contained V	lb.	6.50	—	7.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al. content, less than 2% Fe_2O_3, up to 20% silica, not more than H4% moisture	gross ton	$10.00	—	$11.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	.65		.70
Chrome ore, 50%, Cr_2O_3 f.o.b. Atlantic Seaboard	unit	.60	—	.65
Coke, foundry, f.o.b. ovens	net ton	9.00	—	11.00
Coke, furnace, f.o.b. ovens	net ton	7.00	—	9.00
Coke, petroleum, refinery, Atlantic Seaboard	net ton	24.00	—	26.00
Fluor spar, lump, f.o.b. Tonuco, New Mexico	net ton	17.00	—	.....
Fluor spar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	22.50	—	25.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½	—	.01¾
Manganese Ore, 50% Mn, c.i.f. Atlantic seaport	unit	.....	—	.45
Manganese ore, chemical (MnO_2)	gross ton	55.00	—	60.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.55	—	.60
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	35.00	—	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.12	—	....
Pyrites, Spanish, furnace size, c.i.f., Atlantic seaport	unit	.17	—	......
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	.12	—	.14
Rutile, 95% TiO_2 per lb. ore	lb.	.15	—	....
Tungsten, Scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	6.00	—	....
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	4.50	—	5.00
Uranium Ore (Carnotite) per lb. of U_3O_8	lb.	2.75	—	3.00
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.75	—	3.00
Vanadium pentoxide, 99%	lb.	12.00	—	14.00
Vanadium Ore, per lb. of V_2O_5 contained	lb.	2.00	—	.....
Zircon, washed, iron free	lb.	.05	—	.....

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	15.75
Aluminum, 98 to 99 per cent	32.00
Antimony, wholesale lots, Chinese and Japanese	6.00
Nickel, ordinary (ingot)	43.00
Nickel, electrolytic	45.00
Tin, 5-ton lots	39.00
Lead, New York, spot	7.25
Lead, E. St. Louis, spot	7.05
Zinc, spot, New York	7.00
Zinc, spot, E. St. Louis	6.60

OTHER METALS

Silver (commercial)	oz.	$0.91¼
Cadmium	lb.	1.40@1.50
Bismuth (500 lb. lots)	lb.	2.55
Cobalt	lb.	6.00
Magnesium (f.o.b. Niagara Falls)	lb.	1.75
Platinum	oz.	85.00@ 90.00
Iridium	oz.	350.00@400.00
Palladium	oz.	85.00
Mercury	75 lb.	58.00@ 60.50

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	23.50
Copper bottoms	34.00
Copper rods	29.00
High brass wire and sheets	27.50
High brass rods	19.00
Low brass wire and sheets	30.50
Low brass rods	24.00
Brazed brass tubing	36.25
Brazed bronze tubing	41.50
Seamless copper tubing	28.00
Seamless high brass tubing	27.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy and crucible	12.50	17.00	12.00	13.50
Copper, heavy and wire	12.00	16.00	11.75	12.50
Copper, light and bottoms	10.00	14.00	10.00	11.00
Lead, heavy	5.50	4.75	5.50	6.00
Lead, tea	4.50	3.75	3.75	5.00
Brass, heavy	7.00	10.50	8.00	12.50
Brass, light	5.50	7.50	5.00	6.50
No. 1 yellow brass turnings	7.00	10.00	6.00	6.75
Zinc	4.50	5.00	3.75	5.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.15	$4.47	$3.47	$3.44	$3.37	$4.08	$3.47
Soft steel bars	4.15	4.62	3.37	3.84	3.27	3.98	3.37
Soft steel bar shapes	4.15	4.62	3.37	3.84	3.27	3.98	3.37
Soft steel bands	5.50	6.32	4.07	6.25	....	....	....
Plates, ¼ to 1 in. thick	4.15	4.67	3.67	3.64	3.57	4.28	3.67

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Connecticut

SOUTH GLASTONBURY — The Wasuc Mills Co. plans to build a paper plant to replace the one recently destroyed by fire. Estimated cost, $50,000.

VERSAILLES—The Federal Paper Bd. Co. has awarded the contract for altering and building a 2-story addition to its paper factory to H. Wales Lines Co., 134 State St., Meriden. Estimated cost, $250,000.

District of Columbia

WASHINGTON—The Bureau of Yards & Docks, Navy Dept., has awarded the contract for the construction of laboratory buildings, etc., at the Naval Experimental and Research Laboratory at Bellevue, to Boyle and Robertson, Evans Bldg., at $652,711.

Florida

PALATKA — The United Sugar Corp., 1512 Walnut St., Philadelphia, Pa., will soon award the contract for the construction of a sugar refinery, including mill, etc. Estimated cost, $1,000,000. G. P. Anderson, engr.

Indiana

COLUMBUS—The Indiana Oil Refinery Co. plans to build an oil refinery to have a capacity of 1,000 bbl. O. L. Bartlett, pres.

Iowa

CEDAR RAPIDS—The Bd. Educ. will soon receive bids for the construction of 4 high schools. A chemical laboratory will be installed in each. Estimated cost, $1,200,000. K. Mategill, secy. Frank Tustison and Hugh & Zalesky, 811 Securities Bldg., Des Moines, engrs. and archts.

CORYDON—The Bd. Educ. will receive bids about Dec. 15 for the construction of a 3-story, 67x121-ft. high school. A chemical laboratory will be installed in same. Estimated cost, $160,000. W. Gordon, Hubbell Bldg., Des Moines, archt.

FORT MADISON—Hinde & Dauche Co. plans to build a paper mill. Estimated cost, $100,000.

Louisiana

NEW ORLEANS—The Apex Paper Co., Paris Ave. and the New Orleans Terminal R.R., plans to build a 1-story, 40x90-ft. building addition to its plant. Estimated cost, $50,000. H. W. Schlosser, secy.

NEW ORLEANS—The Linde Air Products Co., 30 East 42nd St., New York City, will build a 1-story, 125x125-ft. oxygen factory. Estimated cost, $300,000. Work will be done by day labor.

Maine

HOULTON—P. J. Sullivan, 74 Broad St., Boston, plans to build a 1-story, 80x300-ft. fertilizer plant.

Massachusetts

DEDHAM—The Third Natl. Film Co., 67 Milk St., Boston, plans to build a large moving picture laboratory here in the spring.

EAST WALPOLE—Bird & Son, Inc., plans to build a 1-story, 50x200-ft. plant for the manufacture of roofing materials, etc. Charles Main, 201 Devonshire St., Boston, engr.

NEWTON—Boston College, Chestnut Hill, plans to build a 3-story science building on College Rd. Estimated cost, $375,000. Maginnis & Walsh, 100 Boyston St., Boston, archts.

SANDWICH — The Sagamore Co., 53 State St., Boston, has awarded the contract for the construction of a 1-story pulp mill, to T. Keliher. Estimated cost, $100,000.

Maryland

BALTIMORE—The Red "C" Oil Mfg. Co., 410 Keyser Bldg., is having plans prepared for the construction of tanks and probably a refinery, on Key Highway. Estimated cost, $250,000. W. W. Pagon, Lexington Bldg., engr.

Michigan

SAGINAW — The Bd. Educ. plans to build a 3-story, 173x282-ft. school on Weadock and Park Sts. A chemical laboratory will be installed in same. Estimated cost, $1,000,000. Cowles & Mutscheller, Chase Blk., archts.

Minnesota

ANNANDALE—The Bd. Educ. is having plans prepared for the construction of a 2-story, 110x154-ft. high school. A chemical laboratory will be installed in same. Estimated cost, $250,000. C. H. Parsons, 600 Builders Exch., Minneapolis, archt.

EVELETH—The Bd. Educ. will receive bids about January for the construction of a 3-story, 140x200-ft. vocational high school. A chemical laboratory will be installed in same. Estimated cost, $750,000. J. M. Stearns, clk. W. T. Bray, 817 Torrey Bldg., Duluth, archt.

LONG PRAIRIE — The Bd. Educ. has awarded the contract for the construction of a 2-story, 75x160-ft. high school to the Carlsted Bros., 542 Builders Exch. Bldg., Minneapolis. A chemical laboratory will be installed in same. Estimated cost, $86,692.

Nebraska

NORFOLK—The Bd. Educ. had plans prepared for the construction of a 2-story high school. A chemical laboratory will be installed in same. Estimated cost, $450,000. J. C. Stitt, archt.

New Jersey

GLEN ROCK (Ridgewood P. O.)—The city will receive bids in March for the construction of a sewage disposal plant, etc. Estimated cost, $300,000. H. J. Harder, engr.

PASSAIC—The Newport Chemical Wks., Inc., 168 River Drive, plans to build a warehouse. R. W. Wiliner, secy.

New York

OSWEGO—The Bd. Educ. plans to build a 3-story, 200x264-ft. high school on Utica St. Laboratory equipment will be installed in same. Estimated cost, $450,000. J. A. Randall, S. A. & K. Bldg., Syracuse, archt. and engr.

SHEEPSHEAD BAY—C. A. Benoit, Jerome Ave., has awarded the contract for the construction of a factory on Jerome Ave., to the Gretsch Eng. Corp., 103 Park Ave., New York City. Estimated cost, $150,000.

Ohio

DAYTON—The Bd. Educ. plans to build a 3-story high school on Summit St. A chemical laboratory will be installed in same. Estimated cost, $750,000. Schenk & William, Mutual Bldg., archts.

Oklahoma

MIAMI—The city has awarded the contract for the construction of a sewage disposal plant, etc., to James & Shoe, City Hall. Estimated cost, $141,000.

Pennsylvania

HAZLETON—The United Filters Corp. is building a plant, including several buildings. Filters for chemical food and mining industries will be installed in same. C. M. Stanley, chief engr.

West Virginia

HUNTINGTON—The Fordlette Engine Co. plans to build a plant for the manufacture of gas engines. Plans will probably include a foundry for castings, machine shop and assembling plant. Estimated cost, $100,000.

Quebec

THREE RIVERS — The Three Rivers Pulp & Paper Co. has awarded the contract for the construction of a pulp and paper plant to William I. Bishop Co., 10 Cathcart St., Montreal. Estimated cost, $500,000.

QUEBEC CITY—P. A. Beaulie, 37 Bourlargue St., will soon receive bids for the construction of a brass foundry including equipment. Estimated cost, $69,000.

New Publications

MECHANICAL ORE SAMPLING IN MONTANA, by H. B. Pulsifer. Published by the State School of Mines, Butte, Mont.

RECENT INCREASES IN THE PRICES OF PETROLEUM AND ITS PRODUCTS, published by the American Petroleum Institute, 15 West 44th St., New York City.

ANNUAL REPORT FOR THE YEAR 1919, published by the Bureau of Mines, State of Colorado, Denver, Col.

THE CHICAGO GEOGRAPHIC SOCIETY, Harry P. Pearson, president, is making plans for the founding of a geographic magazine defined as "an organ of discovery and interpretation disclosing man to man and unifying his family in the exchanges of commerce." The trade and banking interests of Chicago are in favor of this movement because of its value to commerce.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its 1920 meeting Dec. 27, 1920, to Jan. 1, 1921, at Chicago, Ill.

AMERICAN CERAMIC SOCIETY will hold its annual meeting the week of Feb. 21, 1921, at Columbus, Ohio, with headquarters at the Deschler Hotel.

AMERICAN CHEMICAL SOCIETY will hold its sixty-first meeting at Rochester, N. Y., April 26 to 29, 1921.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting at Atlantic City April 21 to 23 inclusive. Headquarters will be at the Hotel Chalfonte.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at New Orleans, Dec. 6 to 9. Headquarters will be at the Hotel St. Charles.

AMERICAN PHYSICAL SOCIETY will hold a meeting Nov. 27 at the Case School of Applied Science, Cleveland, and the annual meeting, beginning Dec. 28, at Chicago, the latter being the occasion of the special quadrennial meeting of the American Association for the Advancement of Science and the Affiliated Societies.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS' 1920 annual meeting will be held in the Engineering Societies Building from Dec. 7 to 10 inclusive.

COMMON BRICK MANUFACTURERS' ASSOCIATION OF AMERICA will hold its annual meeting at the Hotel Pennsylvania, New York City, Jan. 31 to Feb. 4.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at the Statler Restaurant, Newark, N. J., the second Monday of every month.

TAYLOR SOCIETY will hold its annual meeting Dec. 2, 3 and 4 in the Engineering Societies Bldg., New York City. The meeting of Dec. 3 at 8 p.m. will be of special interest to metallurgists. The subject will the "The Long Day in the Steel Industry."

The following chemical societies will meet at Rumford Hall, Chemists' Club, New York City, as follows: Dec. 10, American Chemical Society, joint meeting with Society of Chemical Industry, American Electrochemical Society and Société de Chimie Industrielle; Jan. 7, American Chemical Society; Jan. 14, Society of Chemical Industry, Perkin Medal award; Feb. 11, American Electrochemical Society, joint meeting with Society of Chemical Industry, American Chemical Society and Société de Chimie Industrielle; March 11, American Chemical Society, Nichols Medal award; March 25, Society of Chemical Industry; April 22, Society of Chemical Industry, joint meeting with American Electrochemical Society, Société de Chimie Industrielle and American Chemical Society; May 6, American Chemical Society; May 13, Société de Chimie Industrielle, joint meeting with American Chemical Society, Society of Chemical Industry and American Electrochemical Society; May 20, Society of Chemical Industry; June 10, American Chemical Society.